This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

PUBLIC HEALTH BULLETIN No. 91

JULY, 1918.

EPIDEMIOLOGIC STUDIES OF POLIOMYELITIS IN NEW YORK CITY AND THE NORTHEASTERN UNITED STATES DURING THE YEAR 1916

BY

C. H. LAVINDER, A. W. FREEMAN, and
W. H. FROST

PREPARED BY DIRECTION OF THE SURGEON GENERAL

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

BOSTON MEDICAL LIBRARY
FRANCIS A. COUNTWAY
LIBRARY OF MEDICINE

PREFACE.

It seems only fair to state briefly certain difficulties under whic this report has been prepared. The officers engaged in the studi here reported were assembled hastily upon the outbreak of the ep demic, leaving elsewhere more or less important duties, to whic they necessarily returned upon the completion of their field wor Consequently the authors of this report have been obliged to wo separately—two in Cincinnati, Ohio, and one in New York Cit After submitting their respective parts of the manuscript, they ha not had a satisfactory opportunity to go over together the complet manuscript. Owing to the necessities created by the war the on thing possible has been one or two hurried conferences. The seni author alone has had a chance to examine with care the assem bled manuscript, and he has had to work under difficulties and inte ruptions.

A statement of this kind seems necessary to explain the delay publication, as well as certain deficiencies in the report itself, bot in form and in substance. These deficiencies, under more favorab circumstances, might have been eliminated.

BOSTON MEDICAL LIBRARY
IN THE
FRANCIS A. COUNTWAY
LIBRARY OF MEDICINE

CONTENTS.

Page.
INTRODUCTION 7
Occasion scope, personnel, methods of study, acknowledgments 7
Problem of Poliomyelitis 11
I. PREVALENCE OF POLIOMYELITIS PRIOR TO 1916 24
A. World prevalence, 1840–1915: Historical sketch of epidemic increase. [Table and Chart of Epidemics] 24
Bibliography 35
B. Prevalence in United States since 1909: Statistical study 44
Morbidity statistics 44
Mortality statistics 45
Reported cases and deaths, by States and divisions 48
Deaths and cases, reported and estimated, in principal geographic divisions of United States 60
II. EPIDEMIC OF POLIOMYELITIS IN NEW YORK CITY, 1916 81
Introduction 81
Brief description of the city 81
A. General statistical and epidemiologic study of the epidemic 84
Data and methods 84
Poliomyelitis in New York City prior to 1916 85
Origin of the epidemic, 1916 87
Course of the epidemic, by months 89
Reporting of cases 92
Tables and charts 93
Incidence in New York City 93
Incidence, by boroughs 96
Distribution, by assembly districts 98
Coefficient of dispersion 100
Incidence in child population 102
Spread of the epidemic 104
Spread to other boroughs 106
Age distribution of cases 107
Attack rates at different ages 110
Variations in age distribution during the epidemic 112
Sex distribution of cases 114
Fatality of the epidemic 118
Case fatality, by weeks 118
Fatality, by sex and age 119
Variations in fatality, by boroughs 122
Comparative fatality, males and females 122
Summary 122
Multiple cases in same family 123
Attack rates 124
Time of development of secondary cases 129
Summary 130

II. EPIDEMIC OF POLIOMYELITIS IN NEW YORK CITY, 1916—Continued.

A. General statistical and epidemiologic study of the epidemic—Continued.

Page.
Climatological conditions during the epidemic 130
Summary 133
Mathematical relationships of the epidemic 133
Forecasting the decline of the epidemic 134
B. Intensive study of the epidemic in Richmond Borough 137
Introduction 137
Description of the borough 138
Methods and scope of study 139
Summary of cases—types, sex, fatality 141
Origin and course of the epidemic 142
Geographic distribution of cases, by wards 146
Distribution of cases, by nationality 148
Relations to environmental conditions 149
Relations to milk supply 150
Relations to occupation 151
Relations to schools and institutions 151
Multiple cases in families 152
Secondary cases in families 153
Grouping of cases 154
General contact 156
Time interval between primary and secondary cases 158
C. Summary 158
III. EPIDEMIC OF POLIOMYELITIS OUTSIDE OF NEW YORK CITY, 1916 161
Introduction 161
A. General statistical and epidemiologic study of the epidemic 161
The epidemic area 162
Conditions at the beginning of the epidemic 162
Prevalence, by States 163
Prevalence, by counties 165
Prevalence, by cities 166
Variations in attack rate 167
Spread of the disease, by zones, from New York City 168
Spread of the disease in smaller units of population 170
Hartford County, Conn 171
Geographic situation and travel routes 171
Location and chronology of cases 171
Summary 174
Middlesex County, N. J 174
Geographic situation and travel routes 174
Location and chronology of cases 175
Summary 177
Hunterdon, Warren, and Sussex Counties, N. J 177
Geographic situation and travel routes 177
Location and chronology of cases 178
Individual summaries 178
Summary of county studies 179
Summary of studies of incidence outside New York City 179
Exportation of cases from New York City 181
Cases in persons from New York City 182
Relation of cases from New York City to epidemics in other places 182

III. EPIDEMIC OF POLIOMYELITIS OUTSIDE OF NEW YORK CITY, 1916—Contd.
A. General statistical and epidemiologic study of the epidemic—Continued. Page.
Time elapsing between New York City case and first local case........ 183
Period elapsing between departure from New York City and development of poliomyelitis........ 183
Summary of exportation of cases........ 185
Age distribution of cases, urban and rural........ 185
B. Intensive epidemiologic studies outside of New York City, 1916.. 187
Introduction........ 187
Description of territory involved........ 188
New Jersey........ 188
Hartford County, Conn........ 189
Other territory........ 190
Summary of cases investigated—types, sex, fatality........ 190
Relations to environmental conditions........ 190
Relations to milk supply........ 194
Relations to occupation........ 195
Contact—relations of first cases to previous foci........ 196
Hartford County........ 197
Middlesex County........ 197
Hunterdon, Warren, and Sussex Counties........ 197
Summary of first cases........ 198
Contact—relationships between cases........ 199
Miscellaneous cases........ 200
Multiple cases in families........ 201
Secondary cases in families........ 201
General contact as shown by combined studies........ 202
Development of secondary cases as shown by combined studies........ 203
C. Summary........ 204
IV. MISCELLANEOUS STUDIES........ 206
Paralytic disorders of domestic animals........ 206
Entomological surveys........ 208
Rodent surveys........ 208
Collection of material for experimental studies........ 208
V. FINAL SUMMARY AND CONCLUSIONS........ 209
Appendix (tables and maps)........ 215
Index........ 289

POLIOMYELITIS IN NEW YORK CITY AND NORTHEASTERN UNITED STATES DURING THE YEAR 1916.

INTRODUCTION.[1]

This report is concerned primarily with studies made by officers of the United States Public Health Service upon the epidemic of poliomyelitis which occurred during 1916 in New York City and the Northeastern United States. Secondarily, there have been added collateral material from studies which were thought of sufficient significance to receive attention.

The occasion under which the work reported in this present volume was undertaken can perhaps best be explained by reference to the annual report of the Secretary of the Treasury for 1916. A serious epidemic of infantile paralysis had begun in New York City early in the summer, and the Secretary, in his report, says:

> While in New York City on July 6 I called on Mayor Mitchel and offered the assistance and cooperation of the United States Public Health Service. This offer was promptly accepted and steps were taken immediately by the Public Health Service to make investigations of an epidemiological and laboratory nature. In addition the department took steps to aid local authorities in other States in necessary measures of protection, through a notification system established in New York.

The work of the Public Health Service, therefore, in this epidemic, developed along two lines and was conducted by two entirely different and separate groups of officers. One of these groups, under the charge of Senior Surg. Charles E. Banks, was engaged in the supervision of interstate traffic in relation to the disease and the notification of local health authorities concerning the movements of persons from the epidemic area. The other group of officers, under the supervision of Surg. C. H. Lavinder, was engaged in scientific investigations of the disease. This present report is concerned solely with the work of the latter group.

As originally contemplated the investigation was to include both epidemiologic and experimental studies. By reason, however, of administrative and other difficulties the laboratory work was ultimately transferred to the Hygienic Laboratory in Washington, material for study being supplied from New York City and vicinity. The studies made with this material form no part of this report, which is concerned entirely with the epidemiological and statistical aspects of the question.

---

[1] Manuscript submitted Sept. 8, 1917.

Originally the investigations were confined to New York City, but as the epidemic developed they were extended to the States surrounding New York City. Through access to the records of the city health department, by the courtesy of the commissioner, it was possible in New York City to collect general epidemiologic data with regard to all cases that occurred in the city. Moreover, opportunity was offered to make detailed, intensive studies of all the cases that occurred in one borough—that is, the borough of Richmond, which comprises the whole of Staten Island.

Outside of New York City, through the courtesy of the State health authorities, it was possible to obtain daily general information with reference to the prevalence and spread of poliomyelitis in the States of New Jersey, New York, Connecticut, Rhode Island, and Massachusetts, and also to make detailed studies of cases in certain parts of New Jersey, Connecticut, and Rhode Island. At the conclusion of the epidemic it was feasible to collect information with regard to the disease in certain other States which bore a more or less close relation to the epidemic.

In addition to the above some miscellaneous studies were made, both in New York City and adjacent territory, with regard to the alleged relation of poliomyelitis to certain paralytic disorders in domestic animals. Brief entomological surveys of a very general nature were conducted in various places for a short time. Human autopsy material was collected from a number of autopsies in New York City and elsewhere, preserved in glycerine, and sent to the Hygienic Laboratory for study. Similar material was also sent from several paralyzed animals.

When the question arose as to the tabulation and presentation of the data which had been collected, it seemed wise to make some extension of these studies. Accordingly, as will appear in the following pages, some investigations have been made as to the prevalence of poliomyelitis throughout the world in past years, and particularly its prevalence throughout the continental United States. The disease was not reportable in the United States previous to 1909. Since that date, however, it has been possible to gather more or less fragmentary information as to its prevalence, along with some further information as to age, sex, and seasonal incidence. The epidemic in the northeastern United States during the summer of 1916, with New York City as its central focus, forms the largest epidemic of the disease ever reported, and marks an epoch in the history of infantile paralysis.

Very naturally, in connection with this work, interest has been attracted to the general prevalence of poliomyelitis throughout the

United States during 1916. In addition to the epidemic studied, there were one or two other epidemic foci present in the United States, and moreover there occurred generally a high prevalence of the disease. Difficulty has been met in collecting accurate figures for the entire United States during 1916, but we have tabulated and presented such data as are available. The figures presented are believed to be fairly accurate and comprehensive. This general prevalence of poliomyelitis is of considerable significance in relation to the New York City epidemic.

The methods employed in this work do not differ materially from those in general use in the prosecution of all such work. It may be well to state briefly, however, that the work was organized and conducted from a central office in New York City. This office, by means of a suboffice in the city department of health, was kept in constant daily touch with the development of the epidemic in New York City itself. Through arrangements with the State boards of health in the States surrounding New York City it was possible to receive daily reports of cases occurring in those States, and thus observe also the progressive development of the epidemic in the territory adjacent to the city.

The work done by the field force, being directed from a central office and managed by frequent conferences at regular intervals, was as uniform for all places as local circumstances would permit. In the detailed intensive studies an attempt was made to select such places as would most readily lend themselves to studies of this kind, due consideration being given to relation of such places to the New York City epidemic.

The personnel engaged in this work consisted of service officers of experience. In addition to those whose names appear on the title page as more directly responsible for the preparation of this report the following were engaged in the work for more or less prolonged periods of time:

Surg. Edward Francis.
Passed Asst. Surg. J. R. Ridlon.
Passed Asst. Surg. J. P. Leake.
Passed Asst. Surg. W. F. Draper.
Passed Asst. Surg. L. R. Thompson.
Passed Asst. Surg. J. A. Watkins.
Passed Asst. Surg. G. A. Kempf.
Asst. Surg. H. F. Smith.
Asst. Surg. J. G. Wilson.
Asst. Surg. P. M. Stewart.
Technical Assistant M. B. Mitzmain, entomologist.

Acknowledgment is due all these officers for their share in the work, but special mention should be made of the fact that after the close of the epidemic Dr. Thompson rendered valuable assistance in tabulating and arranging much of the data collected. Thanks are also due Drs. Smith and Stewart for similar assistance.

Some statement of a general nature seems advisable as to the division of labor between the authors of this report. The two important general statistical studies of the epidemic in New York City and outside of New York City were prepared by Dr. Freeman. Dr. Frost is responsible for the section on the "Prevalence of poliomyelitis in the United States, 1909–1915," and the section entitled "The problem of poliomyelitis" is taken, with slight modification, from a previous publication written by him.[1] The rest of the report was prepared by Dr. Lavinder, who acted also as editor. The work of each author has been subjected to the criticism of the others.

In the preparation of the maps and data for the Northeastern United States—that is, the territory comprised in this epidemic—it is a matter of regret that we could not secure comparable data for the State of Pennsylvania. This information has not been available, and it was necessary simply to leave this State blank.

No attempt has been made to include in this report any comprehensive bibliography. Bibliographies upon this disease are readily available, and it seemed unnecessary to repeat them where they did not possess some special significance with regard to this particular publication. It has been thought best, however, to give a rather extensive bibliography for one section of the report, as will be seen by reference to subsequent pages.

This epidemic, by reason of the large populations and wide territory involved and the virulence of the infection, has offered a very exceptional opportunity for studies upon poliomyelitis, especially studies of an epidemiological nature. Statistics of the disease have never before been possible on such a large scale. Their collection and tabulation, even if they do not lead to immediate results of value, will undoubtedly prove of great importance to students of later epidemics. In the presentation of them we have tried to keep this point constantly in view.

It may be wise to state more specifically the ground covered in this investigation in order to give a clearer idea of the studies which are presented in their relations to each other and to the whole.

Besides the preliminary introductory matter already mentioned and the concluding chapter summarizing results, the studies specifically relating to the 1916 epidemic, as reported in the following pages, are as follows:

1. STUDIES IN NEW YORK CITY.

(*a*) A general statistical study based on records collected and made available by the department of health. The object of this study is to give a general view of the epidemic in the city with considerable, but not minute, detail.

---

[1] Hygienic Laboratory Bulletin No. 90.

(*b*) An intensive study of the Borough of Richmond based upon information collected by service officers in a personal canvass. The data thus collected are much more detailed than the above. This investigation serves as a check upon the general data and permits more specific study of individual factors, such as environment, contact, occupation, relation of unrecognized and unreported cases, etc.

(*c*) Some special studies made in cooperation with the department of health and the Hygienic Laboratory. These include investigations as to the prevalence of paralytic diseases among domestic animals, very brief and general entomological and rodent surveys, and the collection of material to be used for experimental purposes.

2. STUDIES OUTSIDE OF NEW YORK CITY.

(*a*) Survey and prevalence of the distribution of the disease in States surrounding New York City, based upon information secured through daily reports from State health authorities and final reports from more distant States. These data include only scant details, sufficient to give geographic distribution, chronology, and, in some instances, age distribution. The object here is to show the mass movement of the epidemic.

(*b*) Intensive studies in small cities and rural districts, made for two purposes: First, to collect information concerning early cases on the advancing fringe of the epidemic in order to establish relation between new foci and New York City, with special attention to exported cases as indicating incubation period; and, second, detailed study of all cases occurring in selected areas, principally smaller cities and country districts, with the object of obtaining comparable data on the behavior of the epidemic in environments radically different from that of New York City.

It is desired to take this opportunity to make special mention of the relations which have existed between ourselves, representing the national health authority, and the various local health authorities with which we have come in contact during the prosecution of this work. The courteous and fine spirit of cooperation exhibited by the local health authorities wherever the investigation extended is a matter of gratification. Wherever necessary individual acknowledgment is made of this cooperation, without which our work could not have been accomplished.

Acknowledgment is also due to the Director of the United States Census Bureau, who, in addition to supplying us with numerous publications, also gave material aid in furnishing certain information not available in published form.

As a preliminary to this report and as a part of this introduction it seems advisable to state, in general terms at least, the problem which confronts the investigator of poliomyelitis.

THE PROBLEM OF POLIOMYELITIS.

The problem presented by poliomyelitis is a difficult one. The need for some satisfactory solution of it becomes each year more and more insistent. The realization of this has stimulated workers in all parts of the world, and we have in consequence accumulated wide knowledge upon many phases of the malady. Certain essential things, however, remain obscure or unknown, and the present status of the question is, in some important respects, highly unsatisfactory.

The development of our knowledge in its larger steps is associated with the names of few men. Poliomyelitis has undoubtedly existed for a long period of years. It is no new disease. It was reserved for Heine, however, about 1840, to differentiate it from the multitudinous forms of paralysis affecting children and place it upon a firm foundation as a clinical entity.

The next great contribution was made by Medin about 30 years later. From a study of Swedish epidemics he confirmed and greatly extended the observations of Heine, and first made clear the symptomatology of the acute form of the disease. In the meantime some advances had been made in our knowledge of the pathology and etiology of the affection with growing suspicion, voiced by Strümpell and others, as to its probable infectious nature.

A further great impetus was received from the notable studies made by Wickman in Sweden during the epidemic of 1905. Besides important pathological studies, he first gave a clear conception of the "abortive" form of poliomyelitis, and by his brilliant and careful epidemiologic studies outlined our present ideas as to the mode of transmission by contact, and the importance of abortive cases and carriers in the spread of the malady.

The experimental production of the disease in monkeys in 1908 by Landsteiner and Popper, and its confirmation and extension by Flexner, Lewis, and others shortly thereafter, opened the way to a field of experimental work which has yielded rich results and added greatly to our information, resulting ultimately in the cultivation in vitro by Flexner and Noguchi of the specific microorganism of the disease.

A host of students in all fields have helped to fill in gaps here and there, until to-day it is safe to say that our knowledge of this disease is in certain respects more accurate and more comprehensive than that of many other infectious diseases with which we have been familiar for a much longer time.

Our conception of the clinical picture of poliomyelitis and our interpretation of the associated pathological changes have since Heine's time undergone a process of evolution. We have thus achieved a comprehensive and consistent point of view not attained by earlier students, among whom poliomyelitis was distinguished almost solely by the sudden development of permanent, flaccid paralysis of muscles supplied from the spinal segments, with no distinctive accompanying symptoms. Corresponding to this clinical picture the essential lesion was considered to be a destruction of motor cells of the anterior cornua, a very natural conclusion, considering that pathological studies were almost wholly confined to cases long past the acute stage.

In contrast to this is the conception, now well established and slowly receiving general recognition, that in poliomyelitis the essential and primary lesion of the nervous system is a perivascular and more or less diffuse round-cell infiltration of the leptomeninges, extending into the substance of the cord and medulla, and accompanied by congestion and edema, most intense around the motor cells of the anterior cornua and the motor cells of the bulb, but by no means confined to these areas, and extending even to the posterior root ganglia. Associated with this are characteristic changes in the cerebrospinal fluid, rather constant though not distinctive changes in the blood picture, and more or less constant lesions in other organs, especially in the glandular appendages of the digestive tract.

Corresponding to this broader pathological picture, it is now recognized that we have paralysis of bulbar as well as of spinal origin, indeed that any motor center whatever may be affected and that the motor function may be impaired to any degree or extent from complete and permanent paralysis to the most transitory paresis, or even, in some instances, a mere disturbance of reflexes. Preceding or accompanying the paralysis we now recognize a fairly characteristic train of more or less severe symptoms: usually an acute febrile reaction; gastrointestinal disturbances of greater or less severity, indications of meningeal irritation, and often sensory symptoms, probably attributable to inflammation of the posterior root ganglia. Finally it is now thoroughly established by clinical observation and special diagnostic measures that poliomyelitis occurs without paralysis, that it is indeed not necessarily a paralytic disease, frequently occurring in so-called abortive forms without impairment of motor functions, sometimes presenting a distinctive clinical picture, at other times with symptoms so mild and so indefinite that a diagnosis can be made only by association with other cases or with the aid of lumbar puncture.

The specific cause of poliomyelitis is a minute microorganism, a so-called virus, capable of passage through dense porcelain filters which are impermeable to ordinary bacteria, hence a filterable virus. The virus of this disease is readily destroyed by heat and the usual chemical disinfectants, but keeps well in glycerine and even in weak phenol, maintaining its virulence under proper conditions for a long period of time. In this and some other respects it is comparable to the virus of rabies and vaccinia. The virus also withstands drying and is rather highly resistant to external conditions. It has been shown to maintain activity in sterilized milk and water for many days. It also withstands freezing.

While opinions are somewhat guarded, it would nevertheless seem safe to say that this specific virus has been successfully cultivated in vitro upon suitable media.[1] Its cultivation is very difficult, and so far it has shown no very significant immunological reactions. It is well known, however, that the immunity conferred by an attack of poliomyelitis is relatively high. Second attacks of the disease are rare. Monkeys successfully inoculated, upon recovery, are thereafter resistant to the virus. It has also been shown that the blood serum of convalescents from this disease contains neutralizing properties against the potent virus.

The virus derived from human cases is pathogenic for apes, producing in them characteristic effects similar to those produced in man. As is the case with many other pathogenic microorganisms, considerable variations in virulence are noted. The only animals other than apes which have been found definitely susceptible to the infection are rabbits. The susceptibility of these animals to the infection appears highly inconstant and the effects produced are both clinically and anatomically quite different from those produced in the monkeys. Some observations have been made which suggest that the guinea pig may at times be susceptible to the infection. The virus, after propagation in a series of monkeys, develops a high degree of virulence for this particular species and produces a high mortality among them.

In the human body the virus is rather widespread. It has been found—

(*a*) In certain tissues and secretions of persons dead of poliomyelitis, especially in the brain and spinal cord, also in the mesenteric glands, in the tonsils, and in the mucous secretions of the nasopharynx, the trachea, and the intestines.

(*b*) In the secretions of persons acutely ill with poliomyelitis, namely, in the nasopharyngeal secretions and in washings from the rectum. The infectivity of these secretions has been demonstrated not only in persons suffering from the clinically typical, paralytic forms of poliomyelitis, but also, though perhaps less conclusively, in the secretions of those suffering from mild, clinically indefinite, abortive forms.

(*c*) In the nasopharyngeal and intestinal secretions of persons convalescent from acute attacks of poliomyelitis. Although the total number of recorded examinations of convalescents is not large, yet the results of studies made suggest that in a large proportion of persons recovering from poliomyelitis these secretions remain infective for several weeks or months.

---

[1] Mathers, Rosenow, and others have recently presented evidence that streptococci may play an important rôle in the etiology of poliomyelitis. At this time the evidence submitted does not suffice for a final conclusion. Whatever may be its nature, the fact that the infectious agent is a filterable virus is thoroughly established.

(*d*) In the nasopharyngeal secretions of apparently well persons who have been more or less intimately associated with those sick of the disease, especially in epidemic foci. With our present knowledge it is impossible to estimate what proportion of persons under such circumstances become carriers, or in an epidemic focus what ratio the number of carriers may bear to the number of those sick with the disease. While the carrier state has been demonstrated experimentally, technical difficulties at present effectually prevent the collection of any extensive statistics upon this important point.

Outside of the human body the living virus has been demonstrated in nature only in the dust of rooms occupied by the sick and presumably contaminated by their secretions; and possibly, though far less convincingly so, upon articles recently handled by the sick.

In brief, there is at present experimental proof of the following sources of infection: The secretions of persons ill with poliomyelitis, those convalescent from the infection, and "passive" carriers—that is, persons apparently well who are harboring the specific virus and discharging it in their secretions.

As to the avenues through which the virus may enter the human body to cause infection, inferences may be drawn chiefly from experiments upon lower animals. Monkeys may be experimentally infected by injection of the virus directly into the brain, or the subdural space, in the general circulation, the peritoneal cavity, or even the subcutaneous tissue. They may also be infected by rubbing the virus upon the scarified mucous membrane of the nose, and even by rubbing it upon the uninjured mucous membrane. Also, by the use of massive doses of the virus and under quite artificial conditions it has been found possible to produce infection by feeding monkeys through a stomach tube. It is significant that the virus can be demonstrated in the blood only at certain periods of the disease, and then with difficulty.

Of the various methods of infection experimentally shown to be possible, infection through the nasal mucosa appears to be the most constant under conditions which might be expected to be approximated in nature.

Concerning the natural vehicles of infection, experiments performed under laboratory conditions are necessarily somewhat inconclusive. The infectiousness of the naso-pharyngeal and intestinal secretions of infected persons and the susceptibility of monkeys to infection through the nasal mucosa indicate very strongly that the disease may be transmitted in nature by such vehicles as may serve to transmit these secretions from infected persons to the respiratory (or digestive) tracts of others—that is, by more or less direct personal contact. The resistance of the virus to the influence of drying and sunlight suggests the probability of the infective agent being conveyed in dust and in fomites, a suggestion strengthened by the experimental evidence of the infectivity of dust from the sick room. To attach great importance to this mode of infection, however, would be foreign to our experience with other pathogenic microorganisms which by reason of their strictly parasitic nature do not survive long in our environment and do not multiply therein.

Experiments showing the possibility of transmitting the infection through the agency of a biting fly (*Stomoxys calcitrans*), and in one instance through the bedbug, although isolated instances done under highly artificial conditions, give some support to the possibility that insects may play part in the natural dissemination of the disease. It has also been shown experimentally that the domestic fly may carry the virus in an active state upon the surface of the body for several days and within the intestinal tract for several hours. This would give the fly significance, however, only as a mechanical carrier.

On the whole, the experimental evidence, taken alone, while not excluding other means of transmission, points to the conclusion that poliomyelitis is a contagious disease, spread from person to person through interchange of infectious secretions, the sources of infection being the clinically definite or indefinite acute cases of the disease, convalescents, and passive carriers.

By reason of variations in the individual epidemics, it is not easy to outline in brief space the epidemiological characteristics of poliomyelitis. Still certain general features have been so constant in all epidemics that they stand out as fairly well established phenomena.

EPIDEMIOLOGIC CHARACTERISTICS OF POLIOMYELITIS.

1. *Geographic distribution.*—Even in the light of our admittedly imperfect statistics, poliomyelitis is known to be of practically world-wide distribution. In a succeeding section may be found a more detailed statement concerning the distribution of this disease throughout the world. It is sufficient here to say that poliomyelitis has become so widespread as to make it evident that this disease is independent of any special climatic or other conditions which are peculiar to any restricted part of the globe.

2. *Seasonal prevalence.*—In respect to season as to climate poliomyelitis occurs under widely varying conditions. Nevertheless, the disease has a very distinctly characteristic seasonal prevalence, quite constantly reaching its maximum, both of sporadic and epidemic prevalence, during the summer and autumn months, and declining markedly during the late fall and winter to reach its lowest point in midwinter and spring. In the southern hemisphere, with

the seasonal change in the calendar, the reverse occurs. This seasonal prevalence may be accepted as one of the most constant characteristics of the disease. In this respect poliomyelitis resembles infections of the digestive tract and certain insect-borne diseases with their high summer prevalence; and is in sharp contrast to those diseases thought to be transmitted by contact through secretions of the respiratory tract, like pneumonia and influenza.

3. *Sporadic and epidemic occurrence.*—The development of epidemicity in this disease in recent years is considered later in this volume. It may be said here, however, that the disease in sporadic, if not endemic, form has existed in Europe and America for many years. One must be cautious, therefore, in ascribing recent epidemics too readily to the introduction of a new infection—a fresh strain of the virus. Doubtless there exist and have existed quite a number of reservoirs of infection capable, under favorable circumstances, of giving rise to epidemic prevalence.

4. *General characteristics of epidemics.*—Since epidemics may show much variation, it must be emphasized that there are exceptions to any broad general statements. Yet, with due regard to these exceptions, there are certain essential things which are fairly generally accepted as being characteristic of epidemic outbreaks of the disease.

(*a*) Irregular geographic distribution of epidemic foci. Most of the epidemic diseases of man, even when transmitted by the lower animals or by insects, are disseminated along routes of travel; and in their spread from a given point are naturally expected to follow along the more important of such routes. It has often been noted, however, that epidemics of poliomyelitis not infrequently display great irregularity in this connection, and do not always show the distribution to be expected as the result of dissemination along the main highways of traffic.

For example, in 1910 there occurred a rather severe epidemic in Washington, D. C., and a proportionately smaller outbreak in Philadelphia, while Baltimore, lying between these two cities, and in daily communication with each, escaped with nothing more than a moderate increase in the number of sporadic or endemic cases. In the epidemic of 1916 New York City and Newark, N. J., both suffered from severe epidemics, yet Jersey City, lying between the two and in intimate daily contact with both, suffered no worse relatively than Baltimore in 1910. Numerous similar instances might be cited from many different epidemics. These instances alone suggest that epidemics may be due to a "place infection," not transferred by human travel—an infection of local water or food supplies, of insects or domestic animals, whose range of travel is more limited than that of man.

(*b*) Rapid spread over wide areas. There are other and almost equally numerous facts, however, which argue strongly against any such idea of "place infection." Chief among these is the rapidity with which epidemics may spread over wide areas. There are numerous instances of such spread, and some of these, on close study, seem to show that the spread was in a general way radial from the earliest focus. Striking examples of this are given by Wickman in his study of the Swedish epidemic of 1905 and by Kling in his description of the Swedish epidemic of 1911. This is also quite evident in the studies of the 1916 epidemic, presented later in these pages.

Such phenomena are not consistent with any idea of a localized "place infection"; and the rapidity of spread has frequently been such as to confirm the supposition that man, the most rapidly and widely traveling animal, is the carrier of the infection.

(*c*) Small total incidence in the population affected. Even during so-called epidemics poliomyelitis has characteristically a small incidence in the total population. To be sure, instances are not wanting of epidemics in which a large proportion, over 1 per cent, of the total population has been attacked, but these are rather exceptional instances and are practically confined to outbreaks in small towns and small rural areas. In a large aggregation of people, such as the population of a city with over 100,000 inhabitants, a county, or a State, epidemics seldom attack more than one in a thousand of the population, often not more than one in two to four thousand. Even New York City, in the severe epidemic of 1916, had a general prevalence of less than 3 per 1,000 of population. The incidence of poliomyelitis, therefore, even in epidemics is frequently less than the usual annual incidence of several of the more common endemic infectious diseases in the same communities, and strikingly less than the incidence which these common diseases frequently attain during epidemics. Notwithstanding this small incidence in the population, epidemics of poliomyelitis are self-limited, invariably declining in any limited area, as a single city or county, within a few months, and as a general, if not invariable, rule not recurring in that locality for a period of at least two years. This characteristic decline of epidemics after only a very small proportion of the population has been attacked appears not to be due to the exhaustion of the sources or the vehicles of infection nor to be dependent altogether upon seasonal conditions. It is, in fact, difficult to account for on any hypothesis other than that of exhaustion of susceptible material in the population.

(*d*) Incidence in rural and urban communities. As has been noted, poliomyelitis is a widespread infection which requires no peculiar local conditions for its occurrence. As a general rule, however, it has been observed that in small towns and in the country epidemics are more intense than in large cities, a larger proportion of the population being attacked in the former. This has been found true not only when individual small towns are compared with large cities, but also for groups of all the smaller towns or all the rural population of a State, compared with all the large cities of the same area. The proportionately greater rural prevalence has, in fact, been so constant as to be unmistakably due not to mere chance but to some fundamental law. It is to be remembered, however, that this applies to epidemics; whether or not the same is true of the endemic or sporadic occurrence of the disease is not fully established.

(*e*) Distribution among the various elements of the population in epidemic foci. The close study of many epidemics has failed to show any significant differences in the incidence of the disease with regard to hygienic or economic conditions. Nor has there been observed any constant difference in the incidence among the different races and nationalities constituting the population in which the disease prevailed. Likewise no constant relation seems to exist with regard to the topographic features of the affected sections.

In one respect, however, poliomyelitis is constantly and very strikingly selective in its incidence, namely, in respect to age, its greatest incidence being always among children, especially those in the first half decade of life. Children under 5 years of age, constituting, in this country, from 9 to 12 per cent of the total population, furnish usually from 50 to 90 per cent of the cases of poliomyelitis. In some epidemics the disease is almost as prevalent proportionately in children between the ages of 5 and 15 as in those under 5 years of age, but adults (those past the second decade), constituting usually over 50 per cent of the total population, seldom furnish more than 10 per cent of the cases, usually a very much smaller proportion.

Poliomyelitis also quite commonly attacks, both actually and proportionately, more males than females. This disproportionate incidence in males, fairly constant in all age groups, is usually most striking in the ages above 15 years.

(*f*) Local sources and routes of infection. Notwithstanding the minute care with which a considerable number of outbreaks of poliomyelitis have been studied, it has almost invariably been impossible to trace, with any degree of accuracy, the exact origin and routes of dissemination of the infection. Among the exceptions to this statement may be noted some of the small outbreaks described by Wickman, where it was possible to trace fairly definite lines of direct and indirect contact between cases; also a small outbreak, likewise reported by Wickman, where the evidence suggested that the infection had been spread through a common milk supply. These, however, are exceptional instances. In general the epidemiologic studies of outbreaks have yielded only negative results. The very fact, however, that the results of study are usually negative has a certain significance.

For example, mass infection of common water and food supplies has been quite generally and definitely eliminated as a probable means of dissemination in the epidemics studied.

In a general way, the incidence of poliomyelitis in different communities has appeared to be roughly proportional to the number of domestic animals present. This is, however, perhaps only another way of stating that the disease has been commonly most prevalent in rural and semirural communities, where domestic animals are usually more numerous in proportion to the population than in large cities. There is no conclusive evidence of a characteristically greater incidence of infection among those persons who, by reason of their occupation or their residence, are most closely and intimately associated with domestic animals.

Domestic animals suffering from paralytic affections, clinically similar to poliomyelitis, have often been found in communities where poliomyelitis was epidemic, but these animals have not appeared sufficient, either in numbers or in the intimacy of their association with cases of poliomyelitis, to account for the epidemics. Also, it has not been shown that the paralyses of animals are essentially similar to human poliomyelitis. Paralytic diseases of lower animals are not very uncommon, and though they have not been fully studied, it appears that they may be due to a variety of causes. It is not even proven that such diseases are actually more common during epidemics of poliomyelitis. It is quite possible that their apparent association with epidemics of poliomyelitis is due to the fact that they are more apt to be noted and reported in communities where the epidemic prevalence of poliomyelitis has attracted attention to them.

Peculiar topographical or meteorological conditions can not be held to account for epidemics, since, as already noted, the range of such conditions under which epidemics have occurred is very wide. The unprecedented prevalence of poliomyelitis in certain sections of the United States in 1909 and 1910, during unusually dry seasons, gave considerable color to the hypothesis that deficient rainfall, with the consequent excessive prevalence of dust, was an important factor in the causation of epidemics, but broader experience has not confirmed this supposition. The fact that an epidemic of poliomyelitis may be declining in one community while in another, so near by as to be under approximately identical meteorological conditions, an epidemic may just be developing, is a further indication that the development and decline of epidemics are to a considerable extent independent of the weather conditions.

The dominant view that poliomyelitis is a contagious disease spread directly from person to person does not receive, on the surface at least, adequate support from the epidemiologic evidence which is ordinarily sought to establish such a conception, namely, the incidence of cases among persons known to have been intimately associated with the sick, and the establishment among those sick of some previous association with other cases of the disease. In other words, we can not show any undue prevalence of the disease among the persons surrounding the patient, nor can we trace satisfactory connection between one case and another previous case.

Frost, for example, in a study of 2,070 persons exposed to poliomyelitis by residence in the same families and the same houses as the sick, showed that only 14 (0.6 per cent) developed the disease in paralytic form. Even assuming that all of these contracted the disease by such association, still the contagiousness of the disease must be slight and far less than that of scarlet fever. The inclusion of abortive and suspicious cases increased this ratio, however, to 3.2 per cent. Similar evidence, with some exceptions, has been afforded generally by the very small incidence of the disease among large groups of children exposed to contagion by association, in schools and institutions, with acute cases.

Taking the evidence from the other point of view, observations in most epidemics agree that only a small proportion of cases can be ascribed to known contact with previous definite cases of the disease. Even including association with merely suspicious cases of illness, the majority of cases of poliomyelitis can not be traced to known contact, either direct or indirect, with previous cases. This apparent lack of relation between cases has in the minds of many cast a serious doubt on the transmissibility of the disease.

Recognized cases of the disease, it would seem, can not be very important sources of infection. If poliomyelitis is a contagious disease confined to human beings, as certainly seems probable, the chief sources of infection must be sought in cases of illness which are not recognized as poliomyelitis, or, more probably, apparently healthy carriers of the virus.

(*g*) Transmission by insects. Aside from the experimental evidence, which in its present state is not satisfactory, the view that the disease in nature is insect-borne rests upon such broad epidemiological characteristics as seasonal prevalence, greater intensity of epidemics in rural than urban communities, and the frequent irregularity of the epidemic spread of the disease. The insect which would fulfill the conditions might be expected to show the following characteristics: Approximately world-wide distribution; maximum prevalence and activity during the late summer and fall, and in certain latitudes at least a diminished prevalence and activity throughout the year; prevalence in large cities as well as small towns and rural districts; comparatively uniform distribution among the various social strata and independence of local hygienic conditions.

While there is much to suggest that poliomyelitis may be an insect-borne disease, yet a careful study of the significant epidemiological factors which might be so interpreted shows that they may be satisfactorily explained also on the theory of direct transmissibility through infectious secretions, and the latter theory is at present supported by better experimental evidence.

Summarizing briefly these various considerations, poliomyelitis is due to a specific infective agent, of which the only demonstrated natural sources are infected human beings, who may be divided into the following groups: The recognized sick, convalescents, the sick not recognizable as poliomyelitis cases, and passive virus carriers apparently in good health. The infective agent is known to be discharged from these sources in the excretions of the respiratory and digestive tracts; it is known to be fairly resistant to the destructive agencies encountered in nature outside of the human body. Perhaps the most significant fact in regard to the experimental transmission of poliomyelitis to monkeys is that they may be infected by rubbing the virus on the nasal mucous membrane. Infection through the digestive tract or through the agency of biting insects has been found more difficult and less constant.

The disease is, in nature, of widespread, though rare, sporadic or endemic occurrence. In epidemics it has occurred in recent years over a large part of the world, the outbreaks being sometimes discrete, at other times spreading rapidly, but irregularly, over wide areas. Such epidemics characteristically run a rather rapid course in a given community, declining after a few months or less, after having attacked (so far as is evident) only a small proportion of the total inhabitants, usually not more than one in a thousand, and do not recur in the same locality for a period of at least two years. In epidemic foci children under 5 are attacked much more often than are older persons, the whole adult population remaining virtually immune in some epidemics.

The rapid spread of epidemics over wide areas, their spontaneous decline after only a small proportion of the inhabitants have been attacked, and, above all, the preponderating incidence in young children, have not been satisfactorily explained by any hypothesis other than that the infective agent, during epidemics, is widespread, reaching a large proportion of the population, but only occasionally finding a susceptible individual, usually a young person, in whom it produces characteristic morbid effects. Assuming this rare susceptibility, the well-established facts collected by epidemiologic studies are compatible with the evidence of laboratory experiments that the disease is directly transmissible from person to person.

As to what constitutes susceptibility or the converse—immunity—practically nothing can be deduced except that age is obviously a factor of importance, susceptibility being generally greatest in the first half decade of life, thereafter progressively diminishing until in adult life there is a very general immunity to natural infection. The reason for this is at present a matter of speculation. Conceivably the greater immunity of adults may be due to a nonspecific resistance, developing naturally with maturity, without reference to previous exposure to or infection with the specific virus of poliomyelitis. On the other hand, there are certain facts which suggest that the very general immunity of adults may be specific, acquired from previous unrecognized infection with the virus of poliomyelitis.

Briefly outlined, this represents essentially the present status of our knowledge of poliomyelitis. It is given in this way largely for the purpose of stating the problem which confronts the epidemiologist who enters upon a study of this disease. The various features mentioned will receive attention in the studies which are to be presented of the epidemic of 1916 in the Northeastern United States.

PREVALENCE OF POLIOMYELITIS PRIOR TO YEAR 1916.

A. WORLD PREVALENCE OF EPIDEMIC POLIOMYELITIS.

From the epidemiologist's point of view poliomyelitis is in reality a disease of our own time. In the course of a few years we have seen apparently the creation and development in this affection of the power of epidemicity. Without doubt this malady has existed in sporadic form for a long period of time. Its clinical features, confused with those of other forms of paralysis affecting children, this disease was not clearly appreciated as an entity until Heine's time (1840). That it did not occur in epidemic form, however, appears a safe assumption. History records no early epidemics of poliomyelitis, and it seems incredible that any of considerable size could have occurred and escaped recognition.

The earliest epidemic recorded in the literature is alleged to have occurred in Louisiana in 1841. This was reported by Colmer. Wickman and other students, however, have questioned, apparently on good grounds, the authenticity of this epidemic.

Colmer's account is very brief and will bear quotation:

> Whilst on a visit to the parish of West Feliciana, La., in the fall of 1841, my attention was called to a child of about a year old, then slowly recovering from an attack of hemiplegia. The parents, who were people of intelligence and unquestionable veracity, told me that 8 or 10 other cases of either hemiplegia or paraplegia had occurred during the preceding three or four months within a few miles of their residence, all of which had either completely recovered or were decidedly improving. The little sufferers were invariably under 2 years of age and the cause seemed to be the same in all, namely, teething.

While in all likelihood this may have been a small epidemic of poliomyelitis, yet the entire lack of details and the character of the evidence presented render questionable its inclusion as a definitely established epidemic of the disease.

There is some disagreement among students as to the first record of any epidemic of poliomyelitis. The epidemic reported in Norway by Bull in 1868 has been questioned by some authors, who consider the first epidemic the one reported by Bergenholz from Sweden in 1881. The matter is perhaps not one of very great importance, but since it involves a difference of some 15 years in the comparatively brief history of the epidemic form of this disease, it is worthy of consideration. All authors agree that the epidemic reported by

Bergenholz is indisputable. It only remains, then, to inquire concerning the earlier epidemic of Bull.

Leegaard,[1] in a recent exhaustive article on the history of poliomyelitis in Norway, has given a full account of the epidemic reported by Bull, and added to it some details subsequently obtained from Bull. In view of all the circumstances, and also of the intrinsic interest of the report itself, Leegaard's account, somewhat freely translated, is here given in full.

Andreas Christian Bull, district physician in the Modums district, reported in 1868 from Odalen as follows:

> Fourteen persons were treated for acute spinal meningitis, of which five died. The disease began with fever, which in most cases was light. The patients suffered from stabbing, tearing pains here and there in different joints and extremities, as well as in the back. In some cases at the same time they suffered from a more or less widespread hyperaesthesia. This was elicited by pressure along the vertebral column, at times only in the cervical region, at other times only in the lower part of the dorsal region. The succeeding symptoms consisted of paresis, or in some cases paralysis, either of one extremity, or more frequently more than one. In the course of three, four, or five days the general symptoms subsided. In one case both lower extremities became lame. As a rule one leg and one arm were affected, sometimes on the same side, sometimes crosswise. In a few cases only one extremity showed more or less stationary paresis, with at the same time a brief and unimportant paresis of another extremity. Paresis of the neck muscles was also observed on one or both sides. There were no signs pointing to a simultaneous lesion of the brain. There occurred some headache, vertigo, and vomiting, which symptoms are to be assumed as a consequence of the fever. It is noteworthy that in no single case did spasmodic contractions occur, nor was any anaesthesia observed. Urination was normal except in one case where there was some retention. The bowels moved normally, except that constipation of short duration occurred at times.
>
> After four or five days of sickness a change occurred. Either the paralysis spread, involving finally the respiratory organs, with death, and toward the last a disturbance of consciousness, after the illness had lasted on the whole about one week; or else all of the febrile symptoms disappeared quite quickly. And along with this, as a rule, the hyperaesthesia of the back and the pains also disappeared, and with the exception of weakness in one or more extremities the patient quickly began to convalesce. In most of the cases the paralysis was not a frank paralysis, usually only a paresis. While the lameness in the beginning involved all of the muscles of the extremity, the later paresis confined itself usually to only one group. In consequence contractures originated by reason of the weakness of the paralyzed muscles. All of the 9 persons who survived are now upon their feet, and 6 of them in the course of the winter have vastly improved. Three, on the contrary, can get along only with the help of crutches. Of the 14 cases 8 were males, 6 females; 12 were children between 4 and 10 years of age, and 2 were grown persons—a young girl of 15 and a young man of 20. In these latter two the paralysis has remained unchanged. Of the 12 children 5 died—4 males and 1 female—while the other 7 have entirely recovered. It would seem, therefore, that in children this illness either quickly leads to death or else leaves no important consequences.

---

[1] Die akuten polio in Norwegen. See Bibliography.

The first case occurred about the middle of May, with four more following in June, eight in July, and one in August. At the time of the first case the weather was unusually hot for the time of year—13° to 16° R. in the shade. After a few days a strong north wind blew. Indeed, the whole summer in this part of the country was unusually warm, with its highest point between July 8 and 16. Each case occurred in very warm weather, and in the hottest weather, between July 8 and 16, six cases occurred, or almost half of the entire number. I am of the opinion that this great heat played some part in the causation. Most of the small patients had bathed once or twice a day before the disease occurred, and on some days many times. It is not apparent that this circumstance had any effect, but such a thing is possible. In my experience repeated bathing on one and the same day produces a very strong cooling of the body.

It does not seem apparent in this small epidemic that contagion played any rôle, because the disease occurred here and there in different places of the district without the possibility of establishing any relation between the various cases or the families of the same. Yet I will state that in one court two children were taken sick at the same time. Moreover, in two places where cases occurred the brother or sister in the same house sickened, but not with an evident spinal meningitis—rather with a light and unimportant form, so that the patient, after the course of a couple of days, was entirely well. Since, however, along with the symptomatology there occurred unimportant tearing pains in the neck, and since, furthermore, we have the circumstance of relationship to a case of the disease as well as the occurrence of a slight paralysis of the upper arm for half a day, I believe that I am able to say in this case that I was dealing with the beginning of the same affection which had previously been observed in the brother or sister. I have observed two cases of this kind where the symptoms were unimportant. These are not included in the 14 cases reported.

It can safely be asserted, in view of this account, that Bull was undoubtedly dealing with an epidemic of poliomyelitis. Moreover, one notes with interest his observations upon the mild types of the disease, which we now recognize as abortive cases. His comments likewise upon the epidemiologic features of this outbreak and the question of contagion remind us forcibly that we are dealing to-day with exactly what Bull was dealing with in this first epidemic recorded in the literature.

Succeeding Bull's epidemic, no other is recorded until that of Bergenholz, which ocurred in Sweden in 1881. This was another small epidemic of 13 cases. From this date forward small epidemics become of increasing frequency. The succession and size of these epidemics is evident from the following table:

TABLE No. 1.—*Recorded epidemics of poliomyelitis throughout the world (including the United States only up to 1909), arranged alphabetically and chronologically.*

Year.	Location.	Number of cases.	Number of deaths.	Case fatality rate.	Reference.
	AUSTRALIA.				
1895......	Port Lincoln......................	14	....	....	Altman.
1903......	Queensbergen, N. S. W...........	6	None.	....	Blackhall.
1904......	Sydney............................	25	....	....	Litchfield.
1904......	Stanmore.........................	34	....	....	Wade.
1904......	Brisbane..........................	108	4	....	Ham.
1908......	Victoria..........................	137	6	....	Stevens.
	AUSTRIA.				
1898......	Vienna............................	42	....	....	Zappert.
1902–9....	Vienna............................	96	....	....	Neurath.
1908......	Steyr.............................	96	16	....	Lindner and Mally.
1998......	Steyr.............................	68	8	11.7	Löcker.
1908–9....	Vienna and Lower Austria.......	555	61	10.99	Zappert, Leiner, and v. Weisner.
1909......	Steirmark.........................	434	....	13	Potpeschnigg.
1909......	Linz and Urfahr..................	77	....	....	Stiefler.
1909–10...	Kärnten...........................	168	....	....	Puschnig.
	BRAZIL.				
1909–11...	Sao Paulo........................	13	....	....	Ferreira.
	CANADA.				
1909......	Montreal..........................	38	....	....	Russel.
1910......	Ontario...........................	354	....	....	Hodgetts.
1910......	Quebec............................	187	....	....	Do.
1910......	British Columbia.................	48	....	....	Do.
1910......	Alberta...........................	27	....	....	Do.
1910......	Other Provinces..................	42	....	....	Do.
	CUBA.				
1909......	Province of Santa Clara..........	140	....	7.89	Lebredo and Ricio.
	ENGLAND.				
1896......	Much Hadham.....................	7	....	....	Pasteur.
1897......	London............................	11	....	....	Buzzard.
1904......	London............................	45	....	....	Batten.
1908......	Upminster........................	8	....	....	Treves.
1909......	London............................	42	....	....	Batten.
1909......	Bristol...........................	37	2	5	Parker.
1910......	Carlisle..........................	34	5	....	Beard (Batten).
1910......	Maryport.........................	13	2	....	Garrow.
1910......	Cerne Abbas......................	16	2	....	Farrar.
1010......	Workington.......................	5	....	....	Garrow.
1910......	South Shields....................	5	....	....	Mostyn.
1910......	Barrow-in-Furness...............	37	....	....	Garrow.
1910......	Melton Mowbay...................	83	....	....	
1910......	Irtlingborough...................	4	....	....	Robb.
1910......	Weymouth........................	5	....	....	Barclay.
1911......	London............................	66	....	....	Batten.
1911......	England[1].......................	[2]1,100	....	....	Do.
1912......	England..........................	[2]800	....	....	180 deaths (registrar general; Parsons).
1913......	England and Wales...............	205	....	....	Report of registrar general.
1914......	England and Wales...............	177	....	....	Do.
	SCOTLAND.				
1894-1908.	Edinburgh........................	76	....	....	Bramwell.
1910......	Edinburgh........................	62	1	....	Low.
1906......	Royal Hospital of Edinburgh.....	27	....	....	Do.
1907......		15			
1908......		10			
1909......		3			
1910......		44			
1910......	Tillicoultry......................	5	None.	....	Currie and Bramwell.
	IRELAND.				
1913–14...	Tyrone, Coagh. Co................	37	....	27	Burgess.

[1] Disease made notifiable Sept. 11, 1911.

[2] About.

TABLE No. 1.—*Recorded epidemics of poliomyelitis throughout the world (including the United States only up to 1909), etc.*—Continued.

Year.	Location.	Number of cases.	Number of deaths.	Case fatality rate.	Reference.
	FRANCE.				
1886	St. Foy-L'Argentiere	13	4		Cordier.
1893	St. Girons	9			André.[1]
1906–10	Toulouse	69			Bezy and Sorrel.
1909	Paris	100	5		Netter.
1910	Various places	[1] 70			Do.
1911	Pologne	166		3.6	Biehler, Mme.
1913	Le Blanc Azay	18	3	6	Veluet.
1914	Flers de l'Orne	13	3		Guinon and Pouzin.
	GERMANY.				
1886		3			Strümpell.
1889	Thuringia	5			Briegleb.
1898	Kiel	4	None.		Von Pleuss.
1898	Frankfort on the Main	15			Auerbach.
1899	Thuringia	5			Briegleb.
1908	Marburg	50			Römer and Müller.
1908	Heidelberg	36			Hoffman.
1909	Westphalia	500		18	Reckzeh.
1909	Hesse-Nassau	130		16	Müller.
1909	Pomerania	51	6		Peiper.
1909	Province of Hanover	34	7		Eichelberg.
1909	Breslau	50			Förster.
1909–10	Schlesweig-Holstein	[2] 132			Myer.
1912	Bavaria	197	20		Uffenheimer.
1913	Heidelberg	71			Lust and Rosenberg.
1913	Hesse	168			Langermann.
	HOLLAND.				
1906–07	Disseminated	(?)			Starke.
1909	Leyden	24			Krause.
1909	Warmsweld	14			Do.
1912	Disseminated	163		4.3	Schippers and De Lange.
	ITALY.				
1883	Arenzano	5	2		Buchelli.
1895	Montespertoli	7	None.		Pieraccini.
1895	Revecca	17	None.		Buchelli.
1897	Conegliano	22			Fabis.
1899	Valley of Arno	5	None.		Simonini.
1903	Parma	26			Lorenzelli.
1909	Adriatic Italy	62			Gioseppi.
1909	Florence and vicinity	60			Mayanz.
	MELANESIA.				
1910	Island of Nauru	700	38		Müller.
	NORWAY AND SWEDEN.				
1868	Norway	14	4		Bull.
1881	Umea, Sweden	13			Bergenholz.
1886	Mandel, Norway	9	None.		Oxholm.
1887	Stockholm, Sweden	43	3		Medin.
1888	Ammeberg, Sweden	14			Larsson.
1895	Stockholm, Sweden	21	None.		Medin.
1899	do	54	3		Wickman.
1899	Bratsburg, Norway	64	2		Leegaard.
1903	Göteborg, Sweden	20	1		Wickman.
1903	Hadeland and Land, Norway	19	4		Gierswold.
1904	Hvaler, Norway	41	6		Nannestadt.
1904	Aafjorden, Norway	20	6		Platou.
1905	Norway	719	111		Harbitz and Scheel.
1905	Southern Sweden	1,031	145		Wickman.
1906	Norway	467		26.57	Leegaard.
1906	Sweden	429			Kling et al.
1906	Smedjebacken, Sweden	50	5		Wickman.
1907	Norway	204		15.2	Leegaard.
1907	Sweden	467			Kling et al.
1908	Norway	59		16.9	Leegaard.
1908	Sweden	317			Kling et al.
1909	Norway	51		15.68	Leegaard.
1909	Sweden	178			Kling et al.
1910	Norway	57		22.81	Leegaard.

[1] About.

[2] Over.

TABLE No. 1.—*Recorded epidemics of poliomyelitis throughout the world (including the United States only up to 1909), etc.*—Continued.

Year.	Location.	Number of cases.	Number of deaths.	Case fatality rate.	Reference.
	NORWAY AND SWEDEN—Con.				
1910	Sweden	180			Kling et al.
1911	Norway	1,158		18.7	Leegaard.
1911	Sweden	3,840			Kling et al.
1912	Norway	183		18.58	Leegaard.
1912	Sweden (see note)				
1913	Norway	221		13.58	Do.
	RUSSIA.				
1905	St. Petersburg	18			Jogichess.
1908	Russia (a village)	49			Schwarz.
1909–10	St. Petersburg	29			Jogichess.
	SPAIN.				
1896	Valls	8			Roset.
	SWITZERLAND.				
1885–1909	Basle (hospital)	77			Hagenbach.
1910	East Switzerland	37	1		Brandenberg.
1916	Lucerne	10			Androussieur.
	UNITED STATES.				
1841	Feliciana, La	10			Colmer.
1893	Boston, Mass	26			Putnam.
1894	Rutland and Proctor, Vt	132	18	13	Caverly and Macphail.
1894	North Adams, Mass	10			Brackett.
1896	Greene County, Ala	15	None.		Bondurant.
1896	Cherryfield, Me	7	1		Taylor, J. M.
1896	San Francisco and Napa, Cal	8			Sherman.
1897	New York, N. Y	12			Taylor, H. L.
1899	Dutchess County and Poughkeepsie, N. Y.	30	1		Mackenzie.
1899	San Joaquin Valley, Cal	4	None.		Newmark.
1900	Gloucester, Mass	32	1		Painter.
1901	San Francisco and vicinity, Cal	55	None.		Woods.
1905	Central Illinois	8			Norbury (Manning).
1906	New York, N. Y	36			Gibney and Wallace.
1907	Oil City, Lehigh, Du Bois, and Ridgeway, Pa.	214			Terriberry and Urey.
1907	New York, N. Y	2,500		5	N. Y. Collect. Invest. Com.
1907	State of Massachusetts	234			Lovett and Lucas.
1907	Galesville, Wis	22			Jegi (Manning).
1907	Oceana County, Mich	20			Griffin.
1907	Du Bois, Pa	100			Free.
1907	Live Oak, Fla	16			Efird (Manning).
1908	Salem, Va	25			Wiley and Darden.
1908	Clearfield, Pa	14			Mills (Manning).
1908	State of Massachusetts	136			Lovett and Richardson.
1908	State of Minnesota	150	13		Hamilton.
1908	Flint, Mich	30	5		Manwaring.
1908	State of Wisconsin	408		15.3	Frauenthal and Manning.
1908	Florida	16			Frost (Manning).
1908	Schenectady, N. Y	29			Clowe.
1908	Lewistown, Pa	30	3		Barnett.
1908	State of Iowa	9			McCreary (Bierring).

NOTE.—Alaska is included neither in this nor subsequent tables. It may be well to mention the fact that the disease has been reported there both in sporadic and epidemic form. The records are fragmentary, but a few cases are reported for 1908, 1910, 1912, and a small epidemic of 30 cases in 1913. See Hasseltine, Public Health Reports, 1911, pp. 548–549 and 633; also Krulish, ibid., 1912, pp. 1733 and 1750, and 1913, pp. 547 and 549. The epidemic is reported by Pierson, Jnl. Am. Med. Ass'n, LXII, No. 9, Feb. 28, 1914.

It should be mentioned also that there was a high prevalence of the disease in Sweden during 1912, which is not shown in the above table for the reason that the number of cases could not be learned. Kling, Pettersson, and Wernstedt (see bibliography) report a large number of cases but do not give the number, since their publication was issued during the year. The omission in the table is not very material.

This table of epidemics, which have occurred throughout the world, has been compiled from an exhaustive review of the literature. Doubtless it contains errors. The compilation of a table of this character from such sources without some omissions is almost impossible. It is thought, however, that the few omissions are not of sufficient importance to interfere with the one purpose for which the table was constructed; that is, to give a comprehensive view of the very rapid and significant spread of this disease within recent years.

No attempt has been made to show, in this table, the general prevalence of poliomyelitis in the countries named. Endemic prevalence has not been recorded to any extent. The intention has been simply to collect, as far as possible, a complete list of epidemics recorded throughout the world. Some of these, it is realized, are so small as hardly to deserve the name of epidemic. The occurrence, however, a few years ago of even a small group of cases was of peculiar significance in the history of poliomyelitis.

Even a superficial examination of the table makes it obvious that figures are lacking for the last three or four years. This is peculiarly striking for Norway and Sweden, for example, where no figures are given after 1913. The present European war has probably interfered with the receipt of reliable foreign statistics. At any rate the necessary information has not been available to bring the table up to date.

It must further be borne in mind, in the consideration not only of this table, but of all statistics of this character, that the figures available before and after the date upon which a disease is officially made notifiable are not comparable. It is especially important to keep this in mind when dealing with poliomyelitis. In most countries this disease has been made notifiable in recent years. For example, in Norway 1904, in Sweden 1905, in the United States in 1909 and 1910, and in England 1911. Subsequent to such dates more reliable figures of total prevalence are often available for a country.

For the present purpose it seems hardly necessary to make any detailed comments on the individual epidemics recorded in this table. With few exceptions they all present certain general features in common. Some of them, either by reason of peculiar circumstances or of special study, are of great interest. Briefly traced, it will be noticed that poliomyelitis as an epidemic disease first appeared in the Scandinavian Peninsula. Several small epidemics are reported in Norway and Sweden through the years up to 1905. In that year these two countries suffered from the first large epidemic of this disease ever recorded, and there were reported from them a total of something like 2,000 cases.

Germany presents a very similar history. Small groups of cases were first recognized in the eighties. These continued up to 1909, when this country suffered a serious outbreak involving Westphalia, Rhineland and Hesse-Nassau with a total of some 1,000 cases.

Quite similarly, Austria began to record small outbreaks in the nineties and suffered the first serious outbreak in 1908–9, with a total of about 1,000 cases.

Among other European countries, Holland, Switzerland, France, Spain, Italy, and Russia have all reported small outbreaks. Epidemics, it will be noted, are also recorded in Australia, with one in Melanesia. The latter was a tropical epidemic of unusual interest, occurring on the island of Nauru almost under the Equator and among a mixed population of natives, Europeans, and laborers from China and from the Caroline Islands, with unusual incidence among the higher age groups.

In the Western Hemisphere the disease has prevailed in Canada, but there is no record of a large outbreak there. Cuba suffered from an epidemic in 1909. The disease has prevailed also in Alaska and a small epidemic is recorded for that country in 1913. There are no reports of consequence from South American countries.

The United States has suffered severely. The same history is presented—small outbreaks over a period of years culminating in 1907 in a large epidemic which occurred in and around New York City. The extent of this outbreak is not definitely known. At the time of its occurrence it was the largest epidemic ever recorded. It has been estimated that this epidemic numbered over 2,500 cases. Subsequent to this date the disease has made more rapid strides, as will appear in the next section, where its prevalence for 1909 and subsequent years is presented in detail.

The epidemics recorded in the table have been arranged in a graphic chart.[1] (See chart No. 1.) This method of presentation shows at a glance the steps in the epidemic development of the disease. Countries in the Eastern Hemisphere are placed in one column and those of the Western Hemisphere in another. The reader is again reminded that reports from many countries are lacking since 1914, and the absence of epidemics in those years may be only apparent.

While the incidence among a population affected by poliomyelitis, even in its severest epidemic form, is usually not high, yet this disease possesses not infrequently the power to spread widely—in fact to become pandemic in a country. It has been suggested that an epidemic of infectious disease may be viewed as the resultant of two excursions—a vertical one representing the heaping up of cases in any locality, as usually shown plotted on a chart, and a lateral one representing the extent of territory covered—the geographic distribution. Epidemic diseases not infrequently show decided variation in these two movements. Certain of them, like dengue for example, show a most striking vertical movement along with a very limited

---

[1] Figures for the United States are given in the table only up to 1909. In the chart, however, the curve for the United States is shown for subsequent years, based upon figures given in the next section (q. v.).

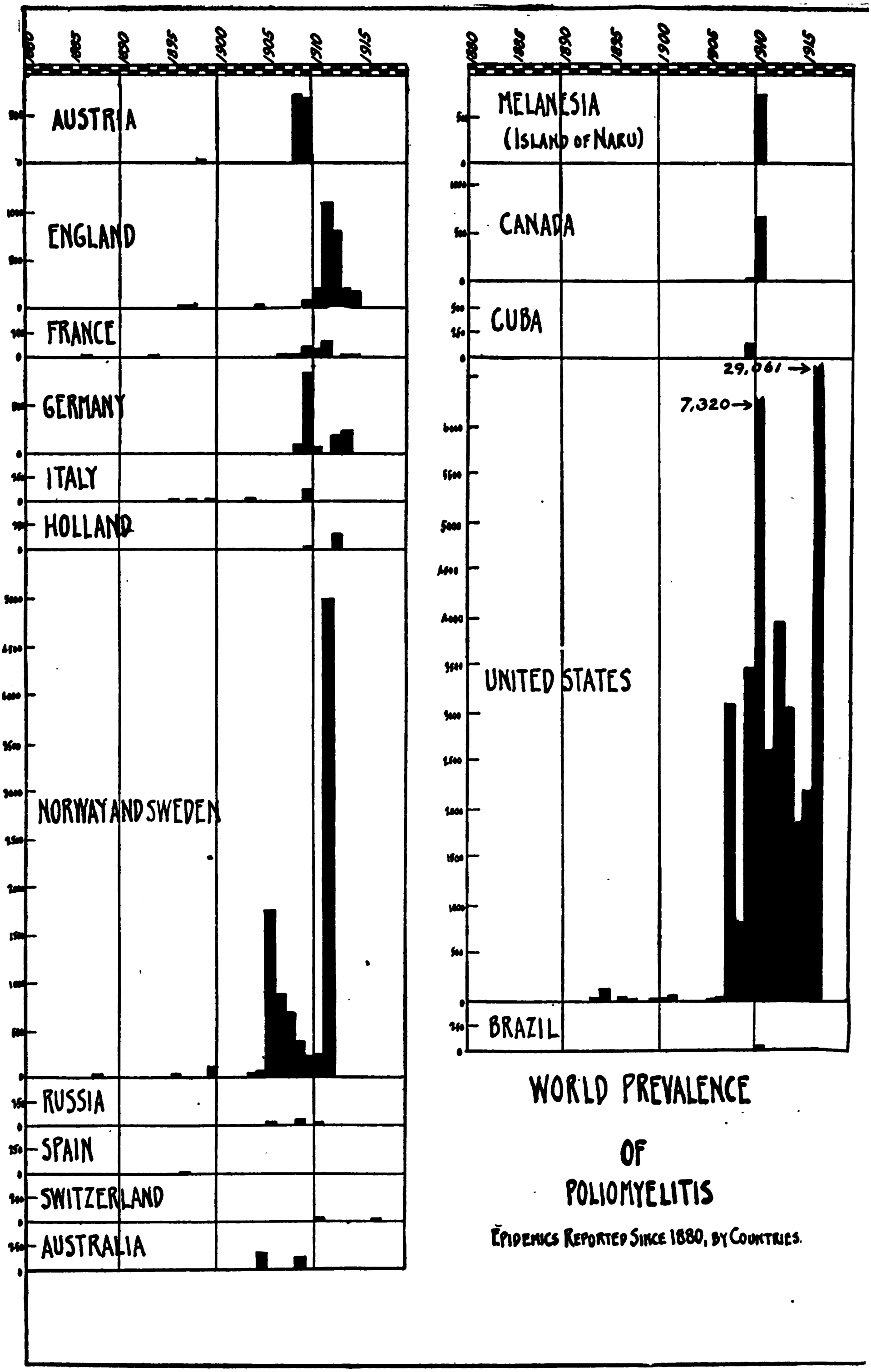


CHART No. 1.

NOTE.—The curve for the United States from 1909–1915 shows total prevalence, and is based on the figures given in the following section of the report.

lateral movement. Poliomyelitis has exhibited a significant power of lateral movement, and, up to the present time, in much greater degree than its power of vertical excursion.

Comment has already been made upon the peculiar irregularity with which this disease sometimes spreads, making wide excursions in one direction or another, and without apparent reason, omitting places which appear to be directly in its path. Nevertheless, within the last few years, it has in its sweep involved to a greater or less degree a very large part of the earth's surface.

Curiously enough, up to the present time the epidemic form of the disease has to a large extent spared the warmer parts of the earth. While the disease has prevailed from the Tropics to the Arctic Zone, yet most of the epidemics are reported from the more northerly and colder climates.

The chronological development of the disease in a country of restricted size and population, where reliable figures are obtainable for a period of years, gives an interesting picture of its progressive spread. Poliomyelitis was early made notifiable in Norway (1904), and Leegaard (loc. cit.) has carefully collected all the statistical data for that country from its earliest records up to 1914. Doubtless no more complete record of the disease exists for any country. In size and population Norway is quite comparable to one of our States. Bearing this in mind we have in Leegaard's chart an excellent picture on a comparatively small scale of the rapid increase in the prevalence of this disease, with its assumption of epidemic force. It is interesting to compare this curve with a similar curve constructed for one of our States, where the disease has received attention and figures are available. Massachusetts, for example, offers such an opportunity (chart No. 2). The figures upon which this chart is based are as follows:

TABLE No. 2.—*Prevalence of poliomyelitis—Cases reported by years, Norway and Massachusetts.*

NORWAY.		MASSACHUSETTS.	
Up to 1904 (disseminated)	295	Up to 1893	26
1904 (at least)	74	1894	10
1905	577	1900	32
1906	467	1907	234
1907	204	1908	136
1908	59	1909	923
1909	51	1910	845
1910	57	1911	260
1911	1,158	1912	169
1912	183	1913	363
1913	221	1914	151
		1915	135
		1916	1,926

The disease was made notifiable in Norway in 1904. Great interest in the disease began in Massachusetts in 1907, and from that time the reported prevalence may be accepted as fairly complete. Leegaard's figures for Norway include only paralytic cases. The Massachusetts figures are, in all likelihood, mostly paralytic cases.

On a large scale the figures available for the entire United States, arranged by groups of years, show an even more striking picture of the rapid increase in this disease in recent years. In round numbers the prevalence of poliomyelitis in the United States may be stated as follows:

For the 20 years 1880 to 1899 (inclusive), reported cases	300
For the 5 years 1900 to 1904 (inclusive), reported cases	100
For the 5 years 1905 to 1909 (inclusive), reported cases	7,500
For the 5 years 1910 to 1914 (inclusive), reported cases	18,800
For the 2 years 1915 to 1916 (inclusive), reported cases	31,500

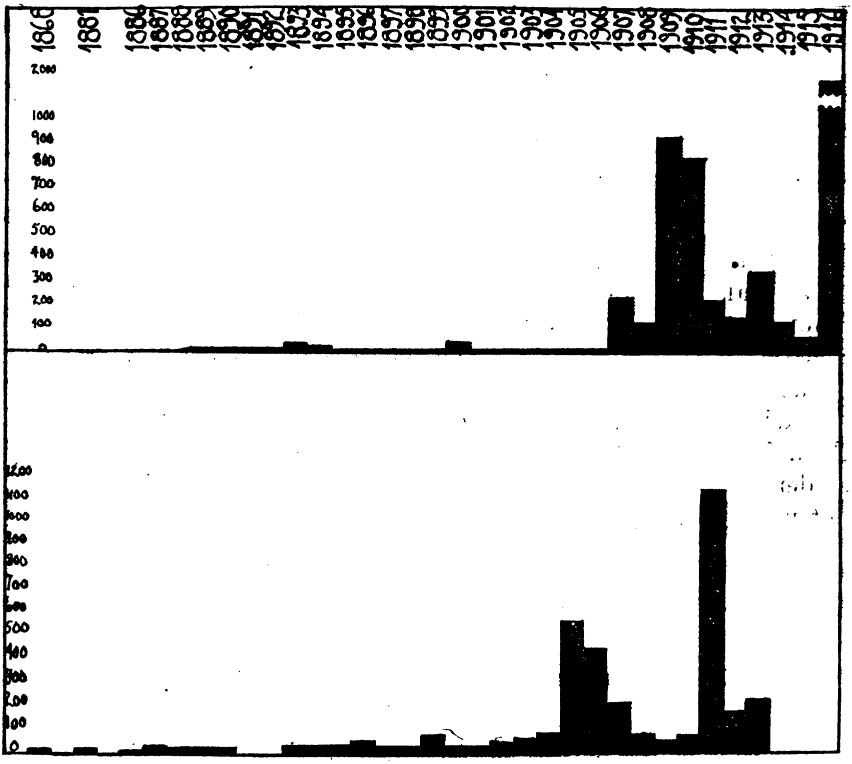


CHART No. 2.—Poliomyelitis. Cases reported, by years, Massachusetts (upper) and Norway (lower).

While the figures may not be so large for other countries, yet relatively many of them show the same rapid increase.

The development in poliomyelitis of the power of epidemicity in all countries affected has been quite similar—first sporadic cases, then small groups, succeeded in time, as the disease gained force, by larger groups, until, as a rule, the disease has culminated in outbreaks of significant proportions. Moreover, this process seems to be a progressive one, and the world was really startled in 1916 by the pandemic which swept the United States, involving numbers far in excess of anything hitherto reported. Romer says:

> The progress of these epidemics is comparable to that of the North American prairie fires, which begin with a small outbreak, spread insidiously, and finally burst into a mighty conflagration.

This somewhat unique creation and development of epidemic force in this disease, together with the fact that this power is apparently increasing, lends to poliomyelitis a gravity which should be fully appreciated. So far in its history this affection in mere numbers can not compare with some of our well-known communicable diseases. Its menace for the future, however, is very real.

The early sporadic occurrence of poliomyelitis and its later epidemic prevalence have possibly been accompanied by some change in the clinical type of the disease. At all events, it has been questioned whether sporadic and epidemic poliomyelitis are one and the same disease. Such a suspicion, however, can hardly longer be entertained. There is a definite clinical similiarity in the cases with the same pathology. The inoculation of monkeys with virus obtained from both sources produces the same characteristic clinical disease in animals with definite pathological findings, and the serological reactions of the two diseases are the same. These facts are sufficient to stamp both diseases as one and the same affection. The variation is one of degree, not of kind.

Excluding the small isolated epidemic in Norway in 1868, we have, then, in poliomyelitis a disease which first displayed, in Europe, evidence of epidemicity in the early eighties, and in the United States not until well into the nineties. The first epidemic of any size did not occur until 1905, and the first real epidemic did not occur in the United States till 1907. In the brief space of the few intervening years the disease, steadily gaining in force, culminated in 1916 in a pandemic sweep through the United States with a total of not less than 30,000 cases, and an epidemic in and around New York City of something like 20,000 cases. This remarkable phenomenon is probably unparalleled by any disease known to medical history.

BIBLIOGRAPHY.

(This list represents only a selected number of titles chosen from the literature reviewed for the foregoing section. The references given were the most useful found for the purpose in view.)

Aaser, E. Eine Poliomyelitis epidemie in Frühjahr 1912 in Lindaas, Norwegen. Berlin. klin. Wochschr., 1914, 51, pp. 246–248.

Altman, C. A. An Epidemic of 14 Cases of Acute Anterior Poliomyelitis. Australasian Med. Gaz., 1897, April 24, p. 173. (Also, Lancet, Lond., July 3, 1897.)'

Anderson, C. A. Report of an Epidemic of 279 Cases of Acute Poliomyelitis. Pediatrics, Aug. 1910, p. 543.

André. Une épidémie de paralysie infantile Polioencéphalite infectieuse. Comp. rend. du Cong. Français de Méd., Bordeaux, 1895, p. 352. (Also, Proceedings of the Medical Congress, Bordeaux, 1895, and Gaz. des Hôpitaux, 1895, Sept. 10, p. 1036.)

Androussieur. Die Heine-Medin. Krankheit in der Schweiz mit bes. Berücksichtigung einer Epidemie in Kanton Lazern in Herbst, 1915. Abstract, J. A. M. A., 1916, LXVII., pp. 841–842.

Armstrong, J. M. A small epidemic of 17 cases of Poliomyelitis. Pediatrics, 1910, p. 486.

Atlee, J. H. Jr. Tenn. State Med. Ass'n., Sept. 1912, p. 185.

Auerbach, S. Jahr. f. Kinderheilk, 1899, vol. L, p. 41. Neurol. Centralbt., 1900, 466.

Baginsky. Zur Kasuistik der Poliomyelitis epidemica. Deutsche Med. Wochenschr., Jan. 20, 1911, vol. 37, p. 145.

Barnett. Therapeut. Gazette, Sept. 1909.

Batten, F. E. Polioencephalitis and Poliomyelitis. 17th Internat. Cong. of Med., Lond., 1913, Sec. 10, p. 145. Proc. Roy. Soc. Med., Lond., 1911–12, pp. 218–219. Brain, Vol. 34, pt. 1, p. 45. Proc. Roy. Soc. of Med., Lond., 1911–12, No. 4, pp. 198–226.

Bergenholz. Referred to by Medin. Hygeia, vol. 52, 1890.

Bézy, P. La paralysie infantile et la meningitis cerebrospinale dans la région toulousaine. Arch. de méd. de Toulouse, 1910, Vol. 17, pp. 505–19.

Biehler, Mme., Mathilde de. Maladie de Heine-Medin, considerations relatives à l'épidémie de 1911 en Pologne. Arch. de méd. des Enfants, Paris, 1914, No. 17, pp. 1–33 and 116–133.

Bierring, W. L. Acute Poliomyelitis in Iowa. Interstate Med. Jour., 1912, No. 19, pp. 35–44.

Blackhall, P. Australasian Med. Gaz., 1904, p. 347.

Boudreau, F. G. & Brain, C. K. Acute Poliomyelitis. Month. Bull., Ohio State Board of Health, Jan., Feb., and Mch., 1914.

Bondurant. Phila. Med. News, Aug. 18, 1900.

Brackett, E. G. Trans. of the Amer. Orthop. Ass'n., vol. 11, p. 132.

Bramwell. Seventy-six cases of anterior poliomyelitis, Clinical Studies, Edin., Vol. 6, 1908, p. 371.

Brandenberg, F. Zur Epidemiologie u. Therapie der epidem. ak. Kinderlähmung. Corresp. Blatt f. Schweiz. Aerzte., 1913, No. 42, p. 1265.

Briegleb. Ueber die Frage der infektiosen Natur der ac. Poliomyelitis. Inaug. Diss. Jena, 1890.

British Medical Journal. (Ed.) Acute Poliomyelitis in Birmingham. Brit. Med. Jour., 1912, No. 2, p. 276.

Buchelli. Il Policlinico, 1897, No. 12, vol. 4, p. 249.

Buzzard. Lancet, Lond., March 26, 1898, p. 847.

Caverly, C. S. History of an epidemic of acute disease of an unusual type. Med. Record, 1894, vol. xlvi, p. 673. Jour. A. M. A., 1896, v. 26, p. 1.

Poliomyelitis epidemic in Vermont, 1914. Pub. Health Reports, Oct. 23, 1914, vol. 29, pt. 2, p. 2826.

Anterior poliomyelitis in Vermont in the year 1910. Bull. Vermont Bd. Health, No. 2, vol. xii, Dec. 1, 1911.

Anterior Poliomyelitis. Ibid. Vol. XIV, No. 4, June 1, 1914.

Epidemic Poliomyelitis, Review of the Epidemics of 1914 and 1915. Ibid., Vol. XVI, No. 4, June 1, 1916.

Clowe. Albany Med. Jour., 1908, vol. 29, p. 799.

Coldewin, Olaf. An epidemic of Pol. ant. ac. Hosten, 1903. Tidsskrift f. d norske laegeforening, 1906, n. f. Jahrg. 26, p. 62.

Collins, Joseph. The epidemiology of Poliomyelitis. J. A. M. Ass'n., June 11, 1910, Vol. LIV, No. 24.

Collins and Romeiser. An analysis of 500 cases of Infantile paralysis. J. A. M. Ass'n., vol. L, no. 22, May 30, 1908, p. 1776.

Colmer, Geo. Paralysis in teething children. Am. Jour. Med. Sci., 1843, vol. 5, p. 248.

Cordier, M. Relation d'une épidémie de paralysie atrophique de l'enfance. Lyon Médicale, Jan. 1, 1888, Vol. LVII, p. 5.

Conn, H. W. The Meriden and Middletown Epidemic of Anterior Poliomyelitis. Report State Board of Health, Connecticut, 1909–10.

Cross. Acute anterior poliomyelitis in S. W. Norfolk. Brit. Med. Jour., Mch. 30, 1912, p. 721.

Currie and Bramwell. A local epidemic of Políomyelitis acuta. Rev. of Neurol. & Psych., 1911, vol. 9, p. 10. Also, Brit. Med. Jour., 1911, No. 2, p. 363.

Cruchet. Etude critique sur les rapports de la méningite cérébrospinale et de la paralysie infantile. Jour. Méd. franc., 1910.

Davis, Herbert. Infantile Paralysis. St. Paul Med. Jour., 1909, p. 630.

Dénéschau et Grosgeorge. Une épidémie de paralysie infantile en Anjou. Paris Méd., April 22, 1911, pp. 484–486.

Dis't. of Columbia Medical Ass'n. Report of the 1910 epidemic. Poliomyelitis Committee of the Medical Association. Wash. Med. Annals, Vol. X, No. 2, May, 1911.

Dixon, Samuel. Pennsylvania's work on Poliomyelitis. Penna. Med. Jour., 1911–12, No. 15, p. 186. Also: Jnl. A. M. Ass'n, 1917, LXVIII, 2, 90.

Dixon and Karsner. Epidemiologic and Etiologic Studies of Acute Poliomyelitis in Pennsylvania. Am. Jour. Dis. of Children, October, 1911, vol. 2, p. 221.

Efird. Trans. Fla. State Ass'n., 1908.

Eichelberg, F. Ueber spinale Kinderlähmung. Deutsche med. Wochenschrift, 1910, Vol. xxxvi, No. 3, p. 112.

Emerson, H. C. An Epidemic of Infantile Paralysis in Western Massachusetts in 1908. Bost. Med. & Surg. Jour., 1909, Vol. 161, p. 115.

England, F. A record of some cases of epidemic paralysis occurring in Hampshire. Brit. Med. Jour., Dec. 3, 1911, p. 1691.

Fabis, P. La Pediatria, May, 1901.

Farrar, Reginald. Report to Local Government Board on Public Health, n. s. No. 61, 1912, p. 103.

Ferreira, C. La Poliomyélite à Sao Paulo (Brèsil). Bull. de la Soc. de Ped., Paris, Oct., vol. 13, No. 7.

Fétra. Early symptoms in 63 cases of the recent epidemic of poliomyelitis. Arch. of Ped., May, 1909.

Fleischner, E. C. California State Jour. Med., Oct., 1911, p. 431.

Förster. Zur symptomatologie der Poliomyelitis acuta anterior. Berl. klin. Wochenschr., 1909, No. 49, vol. 46, p. 2180.

Francis, Edw. Poliomyelitis. A report of an outbreak in Texarkana and vicinity. Pub. Health Rep., vol. xxviii, pt. II, 1913, p. 1693.

Frauenthal & Manning. A Manual of Infantile Paralysis. F. A. Davis & Co., Phila., 1914, 386 p. 8°.

Free, S. M. Jour. Nerv. & Ment. Dis., Apr., 1908, p. 259.

Frost, W. H. Epidemiologic studies of acute anterior poliomyelitis. Washington, 1913, Govt. Print. Office, 258 p., maps, 8°. U. S. Treasury Dept., Hyg. Lab. Bull. No. 90. Iowa Med. Jour., 1910, No. 17, p. 236. Month. Bull. N. Y. State Dept. Health, July, 1911, pp. 165–184.

Fürntratt. Über Poliomyelitisepidemien mit besonderer Berücksichtigung der diesjährigen Epidemie in Steiermark. Das Österreich. Sanitätswesen, Jahrg. xxi, 1909, Beil. zu No. 49, p. 79, Med Blatt., Wein, 1910, Bd. 32, S. 453.

Ganjoux, Emile et Eugène. De l'authenticité des épidémies récentes de paralysie infantile. Gaz. de Hôpit., 1911, Nos. 5 and 6.

Garrow, R. P. Epidemic poliomyelitis in Maryport, Cumberland. Brit. Med. Jour. Supplement, 1910, No. 2, p. 393.

Gasters, Vorläufige Mitteilung über anscheinend epidemisches Auftreten von Poliomyelitis anterior, der sog. Heine-Medinschen Krankheit. Zeitschr. f. Med.-Beamte, 17, 1909, vol. 22, p. 613.

Gibney, V. P., and Wallace, Charlton. The recent epidemic of infantile paralysis. J. A. M. Assn. Vol. xlix, No. 25, Dec. 21, 1907.

Giersvold, E. Epidemisk "poliomyelit," Bacteriologiske undersogelsor. Norsk. Mag. for Laegevideniskaben, Dez., 1905, vol. lxvi, p. 1280. Jahr. f. Kinderh., 1906, vol. lxiv, p. 255.

Gioseffi, M. La paralisi infantile nella nostra regione adriatica. Revista di Clinica Pediatria, 1911, No. 9, fasc 8.

Green, B. F. Anterior poliomyelitis. Jour. Mich. State Med. Soc., 1911, vol. 10, p. 615.

Greene, W. P. Poliomyelitis in Minnesota since 1910. 5th Bien. Report Minn. St. Bd. of Health. Syndicate Publishing Co. 1915, Minneapolis.

Gregor and Hopper. Clinical observations on an epidemic of acute poliomyelitis in Cornwall. Brit. Med. Jour., Nov. 4, 1911, p. 1154. Proc. Roy. Soc. Med. (clin. sec. p. 28), Nov., 1911.

Griffin. Jour. Mich. State Med. Soc., Feb., 1908, p. 142.

Gröber. Zu der rheinisch-westfälischen Epidemie von spinaler Kinderlähmung. Med. Klin., 1909, No. 47.

Grosgeorge, Joseph. La poliomyélite dans l'Anjou. Thèse de Paris, 1910–1911.

Guinon, M. L., and Pouzin (Mme.). Sur une Epidémie recente de Poliomyélite épidémique. Bull. et Mém. Soc. Méd. de Hôp. de Paris, 1914, Tome III, s. 38, pp. 399–411.

Gundrum, F. F. Acute anterior poliomyelitis in California. Cal. State Jour. Med., May, 1913. J. A. M. Assn., Jan. 27, 1912, vol. lviii, No. 4.

Hagenbach, E. Ueber Poliomyelitisepidemien in der Schweiz. Korrespondenzbl. f. Schweiz. Aerzte, Jahrg. 16, p. 1218, 1910.

Hall, J. B. Acute Poliomyeloencephalitis. Jr. National Med. Assn., vol. 3, No. 2, p. 113, 1911.

Ham, B. B. Australasian Med. Gaz., vol. xxiv, p. 193, 1905.

Hamilton. Minn. State Med. Assn. Symposium. J. A. M. Assn., vol. liii, No. 21, Nov. 20, 1909. Wisconsin Med. Jour, April, 1909. Jour. Minn. St. Med. Assn., 1910, no. xxx, p. 2.

Harbitz and Scheel. Pathologisch-anatomische Untersuchungen über akute Poliomyelitis und verwandte Krankheiten von den Epidemien in Norwegen 1903 bis 1906. Christiana, 1907. Akute Poliomyelitis und verwandte Krankheiten, Pathologisch-anatomische Untersuchungen aus den Epidemien in Norwegen 1903 bis 1906. Deutsche med. Wochenschrift, 48, 1907. J. A. M. Assn., 1912, No. 59, p. 782. Ibid., October 26, 1907, p. 1420. Ibid., No. 50, 1908.

Heizer, W. L. Epidemic acute anterior poliomyelitis. Bull. State Board of Health of Kentucky, vol. 2, September, 1912.

Henderson, W. E. Epidemic poliomyelitis in Westmoreland. Jour. State Med., Lond., 1915, vol. 23, pp. 243–251.

Hill, H. W. Epidemiological study of anterior Poliomyelitis in Minnesota. Reprint from Trans. of Sec. on Preventive Med. and Pub. Health of the Am. Med. Ass'n, June 1910. Northwestern Lancet, Sept. 1, 1909.

Hillier, S. Epidemic poliomyelitis occurring at Stowmarket, Suffolk. Brit. Med. Jour., Dec. 30, 1911, p. 1690.

Hodgetts, C. A. Statistics of Infantile Paralysis. Pediatrics, N. Y., 1911, vol. 23, p. 521.

Hoffman, J. Ueber eine Epidemie von Poliomyelitis ant. ac. in Umgebung Heidelbergs im Sommer und Herbst, 1908, und bemerkenswerte Beobachtungen aus früheren Jahren. Deutsch. Zeitschr. f. Nervenheilk., vol. 38, 1909, p. 146.

Holt and Bartlett. The epidemiology of acute poliomyelitis. A study of 35 epidemics. Am. Jour. Med. Sci., May, 1908.

Hounsfield, S. C. Epidemic paralysis. Brit. Med. Jour., 1911, No. 2, p. 1471.

House, W. Acute anterior poliomyelitis. Northwest. Med., Seattle, Wash., Sept., 1910, No. 2, p. 259.

Hyde, Geo. E. Anterior poliomyelitis in Idaho. Northwest. Med., 1910, No. 2, p. 327, n. s.

Jegi, H. A. Tr. T. P. C. Co. Med. Soc. And, Wis. Med. Jour., April, 1909, p. 613 (Manning).

Jogichess. Zur Epidemiologie der Pol. ac. ant. Münch. med. Wochenschr., 1910, Bd. 57, S. 2058.

Jubb, Geo. A third outbreak of Poliomyelitis at West Kirby. Lancet, Lond., Jan. 9, 1915, No. 1, p. 67. Ibid., 1913, No. 2, p. 1380.

Kandutsch. Einige Erfahrungen über Heine-Medinschen Erkrankungen im Bezirk Deutsch-Landsberg (Steiermark). Der Amtsarzt., II, 1910, No. 11, p. 489.

Kansas State Board of Health. Bulletin, July 1910, vol. vi., No. 7.

Kerr, Le G. Acute anterior poliomyelitis. Is efficient treatment of the onset possible? Long Island Med. Jour., November, 1909.

Kling, C., Pettersson A., and Wernstedt, W. Investigations on epidemic infantile paralysis: A report from State Med. Inst., Sweden to XV Int. Congress on Hyg. and Demog., Washington, 1912. Uppsala, 1912.

Koplik. Acute poliomyelitis. An epidemic. Archiv. of Ped., May, 1909, p. 321.

Kramer, F. Die spinale Kinderlähmung. Med. Klin., December 26, 1909, No. 52.

Krause. Zur Kenntniss der westfälischen Epidemie von akuter Kinderlähmung. Deutsche med. Wochenschr., 1909, October 21, p. 1822. J. A. M. Assn., vol. liii, No. 19, Nov. 6, 1909, p. 1575.

Kurze Mitteilung über die rheinisch-westfälische. Epidemie von akuter Kinderlähmung. Verhandl. d Kongress f. inn. Med., Wiesbaden, 1910.

Die akute epidemische Kinderlähmung. Therap. d. Gegenwart, 1911, Nos. 4 & 5, p. 145.

Langermann. Die Kinderlähmung in Grossherzogtum Hessen wahrend der Jahre 1909 bis 1914. Zeits. f. Hyg. u. Infektionskr., 1915, No. 80, pp. 65–113.

Ueber die Verbreitung der akuten epidemischen Kinderlähmung in Kreise Giessen. Berl. klin. Wochenschr., Dec. 27, 1909, p. 2358.

Ueber das Vorkommen von epidemischer Kinderlähmung im Kreise Giessen. Korrespondenzbl. d. ärztl. Vereine des Grossherzogtums Hessen, No. 12, 1909.

Larsson, J. Quoted in Kling, Petersson & Wernstedt (q. v.).

Lasch, Richard. Zur Epidemiologie der Poliomyelitis ant. ac. Der Amtsarzt, vol. 1, 1909, p. 533.

Levredo, M. G. & Ricio, A. Poliomyelitis anterior aguda epidemica. Sanidad y Beneficencia, 1910, vol. 3, p. 170.

Leegaard, C. Om poliomyelit med. demonstration af mikroskopiska präparater. Forhandl. paadet 3 norske laegemode i Bergen, August, 1889, p. 73. Neurol. Centralblatt, 1890, vol. ix, p. 760.

Beretning om en epidemi of poliomyelitis anterior acuta i Bratsberg amt aar, 1899. Norsk. Mag. for Laegvid., 1901, No. 16, p. 377.

Die akuten Poliomyelitis in Norwegen. Deutsch Zeitschr. f. Nervenheilkunde, vol. 53, pp. 145–262, 1914.

Linder and Mally. Zur Poliomyelitisepidemie in Ober-Österreich. Deutsche Zeitschr. f. Nervenheilk., Bd. 38, S. 343.

Litchfield, W. F. Australasian Med. Gaz., 1904, July 20, p. 346.

Löcker. Die Poliomyelitisepidemie im österreichischen Landbezirke Steyr. Das Österreichische Sanitätswesen Jahrg. 21, 1909, Beil. zu No. 49, p. 71.

Lorenzelli, A. La Pediatria, 1904, p. 428.

Lovett, R. W. J. A. M. Assn., 1915, vol. 64, No. 2, pp. 2118–23.

The occurrence of infantile paralysis in Massachusetts in 1909. Monthly Bulletin, Mass. State Board of Health, June, 1910.

The occurrence of infantile paralysis in Massachusetts in 1907. Bost. Med. & Surg. Jour., July 20, 1908.

Infantile paralysis, J. A. M. Assn., No. 20, 1908.

The occurrence of poliomyelitis in Mass. Wright & Porter Print. Co., Boston, 1910.

The occurrence of infantile paralysis in the United States and Canada in 1910. Am. Jour. Dis. of Children, Aug., 1911, vol. 2. Tr. Am. Ped. Soc., vol. 23, 1911, pp. 175–185.

A study of anterior poliomyelitis with analysis of 647 cases from the Children's Hospital in Boston. Med. Record, vol. 73, p. 1098.

Lovett & Emerson. The occurrence of infantile paralysis in Massachusetts in 1908. Month. Bull. Mass. State Board of Health, July, 1909.

Lovett and Lucas. J. A. M. Assn., 1908, vol. 51, Nov. 14.

Lovett and Richardson. Infantile paralysis in Massachusetts, 1907–1910. Am. Jour. Dis. of Child., Dec., 1911, vol. 2, No. 6, p. 369.

Lovett and Sheppard. Infantile paralysis in Massachusetts in 1910. Reprint from the Monthly Bull. of the Mass. State Board of Health, 1911.

Low, H. B. Acute poliomyelitis. An analysis of 62 cases occurring in and around Edinburgh in the epidemic of 1910. Proc. Roy. Soc. Med., February, 1912. (Clin. sec., p. 76.)

Lundgren, H. Hygeia, 1906, p. 1089.

Lust and Rosenberg. Beitrag zur Aetiologie der Heine-Medinschen. Krankheit. Münchener medizin. Wochenschrift, lxi., No. I, Jan. 20, 1914. p. 121.

McClanahan, H. M. A brief report of the Nebraska epidemic of poliomyelitis. J. A. M. Assn., Oct. 1, 1910, vol. lv, No. 14.

Macewan, H. A. Report to local government board on the prevalence of poliomyelitis in certain districts of Lancashire and Westmoreland, 1913. Rep. to L. G. B., Lond., 1914, n. s. No. 98.

Mackenzie, D. Epidemic poliomyelitis with a report of 10 cases. Med. Record, 1902, vol. 62, p. 528.

Maclaren, Rory. Poliomyelitis in a country town. Public Health, Lond., 1914–15, vol. xxviii, pp. 67–70.

Manning, Jacolyn. A partial report of the epidemic of acute anterior poliomyelitis in the State of Wisconsin during 1907–8. Wis. Med. Jour., April, 1909, vol. vii, p. 611.

Manwaring. Poliomyelitis in Flint, Michigan. Jour. Mich. State Med. Soc., April, 1909, vol. 8, no. 4, p. 161.

Mayanz, Fanny. La distribuzione della poliomielite in Toscana. Revista di Clin. Pediat., Firenze, 1911, vol. 9, pp. 710–721.

Medin, O. Über eine Epidemie von spinaler Kinderlähmung. X. Internat. med. Kongr. Berlin, 1890. Hygeia, 1890, vol. lii.

Om den infantile paralysien. Nord. Med. Ark., 1896, vol. 28, no. 1.

L'état aigu de la paralysie infantile. Arch. de méd. des enf. May–June, 1898, vol. I, p. 259 and p. 321.

Meyer, M. Ueber die Heine-Medinschen Krankheit (spinale Kinderlähmung) in der Provinz Schleswig-Holstein in den Jahren 1909–10. Arch. f. Kinderheilk., vol. 56, p. 46, 1911.

Michigan Department of Health. Acute anterior Poliomyelitis. Public Health, 1911, vol. vi., no. 2, p. 77.

Moir, J. H. Epidemic anterior poliomyelitis in South Derbyshire. Brit. Med. Jour., Dec. 30, 1911, p. 1693.

Moss–Blundell, C. B. Epidemic Poliomyelitis in Huntingdonshire. Brit. Med. Jour., 1911, No. 2, 1157.

Müller, A. Eine epidemische auftretende Erkrankung des Nervensystems auf Nauru. Arch. f. Schiffs. u. Tropenhyg., 1910, vol. xiv., p. 535.

Müeller, Ed. Ueber die epidemische Poliomyelitis. Archiv. f. Kinderheilk., vol. 53, p. 180.

Epidemiologie der spinalen Kinderlähmung. Deutsche Zeitschr. f. Nervenheilk., Beil. 45, Heft 3.

Die Spinale Kinderlähmung, Berlin, 1910.

Nannestadt. Epidemie von Poliomyelitis ant. ac. im Bezirk Hvaler im Sommer 1904. Norsk. Mag. for Laege., 1906, vol. lxvii, pp. 409–424.

Neurath. Klinische Studien über Pol. II. Klinische Untersuchung an 240 Fallen von spinalen Kinderlähmung. Jahr. f. Kinderheilk., 1905, 61, Heft 5, s. 742.

Erfahrungen über die Poliomyelitis Epidemie 1908–9 in Wien. Vortrag gehalten auf den XVI Internat. med. Kong. in Budapest, 1909. Abstract in Wiener Klin. Wochenschrift, 1909, p. 1263.

Nonne. Berl. klin. Wochenschr., 1909, No. 41.

Netter, A. Apparation sous forme épidémique de la paralysie infantile à Paris et sa banlieue en 1909. Bull. de l'Acad. de Méd., May 31, 1910, pp. 458–482.

Frequence isolité de Poliomyélitis en France pendant l'été et l'automne 1909. Bull. et Mem. Soc. Méd. des Hopit., Nov. 12, 19, 26, 1909, et Dec. 31, 1909, Bul. Acad. Méd. de Paris, 1911, 3, s. 65, pp. 591–624.

Nevada. Bien. Report of the Nevada State Board of Health. Dec. 31, 1912, and Dec. 31, 1914.

Newmark, L. A little epidemic of poliomyelitis. The Phila. Med. News, Jan. 28, 1899, vol. lxxiv, p. 101.

New York Collective Investigation Committee. Epidemic Poliomyelitis. Report on the N. Y. Epidemic of 1907. The Jour. of Nerv. & Mental Disease Publishing Co., N. Y., 1910.

O'Reilly, Archer. A report on the prevalence of Infantile Paralysis in Missouri. Jour. Missouri State Med. Assoc., November, 1911.

Orbison, T. J. Epidemic Poliomyelitis in Los Angeles. Cal. State Jour. Med., Oct., 1912, p. 402.

Orr, H. W. The epidemic of acute anterior poliomyelitis (epidemic spinal paralysis) in Nebraska, 1909. Am. Jour. Orthop. Surg., Feb., 1911, vol. viii, no. 3, p. 594.

Oxholm, N. Tilfaelde af omtrent samtidig optraedente Lammelse hos Börn. Tidskrift. f. prakt. Med., 1887.

Packard, F. A. Acute anterior poliomyelitis occurring simultaneously in a brother and sister. Jour. Nervous and Ment. Dis., 1899, p. 210.

Painter, C. An epidemic of infantile paralysis. Bost. Med. & Surg. Jour., Dec. 11, 1902, vol. cxlvii, p. 633. Trans. Am. Orthop. Ass'n, 1902, p. 414.

Parker. An epidemic of infantile paralysis in Bristol. British Med. Jour., Mar. 18, 1911, vol. I, p. 609.

Parsons, Leonard. Acute epidemic poliomyelitis. A review. Public Health, Lond., 1913, vol. xxvii, no. 1, pp. 3–10.

Pasteur. An epidemic of infantile paralysis occurring simultaneously in a brother and sister. Trans. Clin. Soc., 1897, vol. 30, p. 143 (Lond.).

Patterson, O. M. My experience with poliomyelitis or infantile paralysis as health officer for the Parish of Morehouse during 1911. New Orleans Med. & Surg. Jour., May, 1913, vol. 65, p. 812.

Peiper, E. Das Auftreten der spinalen Kinderlähmung (Heine-Medinsche Krankheit) in Vorpommern. Deutsche med. Wochenschr., 1910, vol. xxxvi, no. 9, S. 398.

Physicians Investigating Committee of Los Angeles. Report of the investigation of the Los Angeles epidemic of infantile paralysis. South. Calif. Practitioner, 1912, No. 27, pp. 496–512.

Pieraccini. Una epidemia di paralisi atrophica spinale infantile. Lo Sperimentale, 1895, Sept. 21, vol. xlix, no. 27.

Pierson, R. H. Epidemic poliomyelitis and distemper of dogs. J. A. M. Assn., Feb. 28, 1914, vol. lxii, no. 9.

Platou, E. Nogle oplysinger om en epidemi af pol. ant. ac. i Aafjörden hösten, 1904. Tidskrift. f. d. norske laegeforening, 1905, vol. xxv, no. 17.

Von Pleuss, A. Ueber gehäuftes Vorkommen spinaler Kinderlähmung. Diss., Kiel, 1899.

Potpeschnigg. Beobachtungen und Untersuchungesergebnisse aus der steiermärkischen poliomyelitis epidemie im Jahre, 1909. Arch. f. Kinderheilk., Stuttg., 1910, Bd. liv., S. 343.

Puschnig, R. Die poliomyelitisepidemie des Jahres 1909–10 in Kärnten. Das österreich. Sanitätaswesen, 1911, 1912, and 1916, pp. 113 and 157,

Putnam, J. J. Bost. Med. & Surg. Jour., Nov. 23, 1893.

Reckzeh. Die akute spinale Kinderlähmung im rheinisch-westfälischen Industrie-bezirk. Med. Klin., 1909, No. 45, p. 1704.

Reece, R. J. Prevalence of ac. polio. in Devonshire and Cornwall in 1911. Report to the Local Gov't Board, n. s. 61, 1912.

Certain aetiological considerations arising from observations of the behavior of polio. in Devon and Cornwall, 1911. Proc. Roy. Soc. Med. (Epidem. Sec.), 1912, p. 59.

Renault, M. J. Apropos de la poliomyélite épidémique. Bull. et Mem. Soc. Méd. des Hopit. de Paris, 1910, vol. xxx, p. 506.

Römer and Müller. Münch. Med. Wochenschrift, 1909, no. 48, p. 2460. Ibid., 1909, no. 49, p. 2505.

Römer, Paul H. Epidemiologische und ätiologische Studien über die spinale Kinderlähmung. Verhandl. des Deutschen Kongresses f; inn. Med., Wiesbaden, 1910.

Epidemic Infantile Paralysis. Wm. Wood & Co., New York, 1910.

Roth, Paul B. Report and remarks on a small epidemic of poliomyelitis. Lancet, Lond., 1913, No. 2, pp. 1378–1380. Same report in—Proc. Roy. Soc. Med., 1913–14, vol. 7, pp. 47–54 (Surgical Section).

Roset. Pequeña epidemia de poliomyelitis anterior aguda infantil. Med. de los niños, 1905, no. 4.

Rowland, R. H. Physician & Surgeon, Detroit, 1911, no. 33, p. 159.

Russel, Colin K. A contribution to the study of acute poliomyelitis based on the observation of 38 cases with two autopsies. Pediatrics, 1910, p. 518.

Sawyer, W. H. 1910 Epidemic of Poliomyelitis in Hillsdale County, Michigan. Physician & Surgeon, Detroit, 1911, no. 33, p. 155.

Schippers, J. C., and De Lange, C. Ueber eine Epidemie der Heine-Medinschen Krankheit in der Niederlanden während des Jahres 1912. Zeitschr. f. Kinderheilk., Orig., 1913, vol. 8, p. 359.

Schreiber, Georges. La Poliomyélite Epidémique. Thèse de Paris, 1910–11.

Schwarz. St. Petersburg med. Wochenschrift, Jan. 10, 1909.

Sharp, E. A. The aborted forms and pre-paralytic state of acute poliomyelitis as observed in the Buffalo epidemic. Jour. Nerv. and Ment. Dis., May, 1913, vol. 40, p. 289.

Sherman, H. M. Occid. Med. Times, August, 1897, p. 445.

Shidler, G. P. The epidemic of spinal disease in Nebraska. J. A. M. Assn., 1910, Jan. 22, vol. liv, no. 4.

Simonini, R. Gaz. degli. Osp. e delle Cliniche, Apr. 9, 1899.

Soltau, A. B. Acute poliomyelitis. Brit. Med. Jour., 1911, No. II, pp. 1151–1154.

Sorel, E. Étude critique de quelques cas de paralysie infantile épidémique. Arch. Méd. de Toulouse, 1910, vol. 17, pp. 394–401.

Spieler, F. Zur Epidemie der Heine-Medinschen Krankheit in Wein, 1908–09. Wiener med. Wochenschr., 1910, 13, bd. lx, S. 742.

v. Starck. Gehäuftes Vorkommen spinaler Kinderlähmung. Münch. med. Wochenschr., 1910, no. 34.

Starr, M. Allen. Epidemic Infantile Paralysis. J. A. M. Assn., July 11, 1908, vol. 51, no. 2, pp. 112–120.

Stevens. Recent epidemics of 135 cases of acute anterior poliomyelitis occurring in Victoria. Intercolonial Med. Jour. of Australia, Nov. 20, 1908.

Stiefler, G. Ueber die epidemische spinale Kinderlähmung und ihr Auftreten in Oberösterreich. Med. Klinik., Oct. 30, 1910, no. 44, p. 1743. Wien, klin. Wochenschr., 1915, xxviii, 1079–82.

Strang, D. M. Epidemic Infantile Paralysis. Jour. Minnesota State Med. Assn. & Northw. Lancet, July, 1909.

Sturm. Spinale Kinderlähmung und epidemische Parese bei Hunden. Berl. tierärzl. Woch., Vol. XXV, p. 867, 1909.

Taylor, H. L. Is infantile paralysis epidemic? N. Y. Med. Jour., 1897, Vol. LXVI, p. 192.

Taylor, J. M. An epidemic of poliomyelitis. Phila. Med. Jour., Jan. 29, 1898, vol. 1, p. 208.

Terriberry. Long Island Med. Jour., December, 1907.

Tinel-Giry, Mme. La Poliomyélite Épidemique. Thèse de Paris, 1910–11.

Tomkeys, L. S. Acute Poliomyelitis in South Staffordshire. Brit. Med. Jour., Jan. 27, 1912, p. 182.

Treves, W. W. An epidemic of acute poliomyelitis. Brain, November, 1909, 32, p. 285.

Tuttle, Geo. M. Clinical experience with acute poliomyelitis in 1912. Weekly Bull. St. Louis Med. Soc., 1912.

Uffenheimer, A. Der Stand der Heine-Medinschen Krankheit in Bayern. Münch. med. Wochenschr., 1913, vol. 60, no. 2, pp. 2833–2837.

Urey. Poliomyelitis; epidemiology. Penna. Med. Jour., 1908–9, Vol. XII, p. 782.

Veluet. Epidémie de poliomyélite. Le Poitu Medical, 1914.

Wade. Australian Med. Gaz., 1904, July 20, p. 1344.

Washington State Board of Health. Studies in infantile paralysis during 1910 by the Washington State Board of Health. Published by the State.

Wickman, I. Beiträge zur Kenntnis der Heine-Medinschen Krankheit (Poliomyelitis acuta und verwandter Erkrankungen). Berlin, 1907. Also Acute Poliomyelitis (Heine-Medin's Disease), New York, 1913.

Wiley and Darden. An epidemic of acute anterior poliomyelitis. Jour. A. M. Assn., Feb. 20, 1909, vol. 52, no. 8.

Wollenweber. Beobachtungen über die epidemisch auftretende Spinale Kinderlähmung. Zeitschr. f. Medizinalbeamte, No. 21, 1909.

Woods, A. Occidental Med. Times, March, 1903, Vol. XVII, p. 77.

Zappert, J. Ueber gahäuftes Auftreten und Gelegenheitsurache der Poliomyelitis. Jahrb. f. Kinderheilk, 1901, Vol. LIII, p. 125. Klinische Studien über Poliomyelitis. Jahrb. f. Kinderheilk., N. F., 3, Heft 2, 1901.

Zappert, Leiner and v. Weisner. Studien über die Heine-Medinsche Krankheit (Poliomyelitis acuta). Leipzig u. Wien, 1911, 206 p., 8 pl., 8°.

B. THE PREVALENCE OF POLIOMYELITIS IN THE UNITED STATES 1909–1915.

Any attempt to make a statistical study of the total prevalence of poliomyelitis in the United States, whether it be based upon mortality or morbidity statistics, must be limited to the years since 1909. Prior to that year deaths from poliomyelitis were not tabulated separately in the mortality statistics of the United States Census Bureau, but were included under the group heading of "Deaths from other diseases of the nervous system." In Massachusetts the State board of health began in 1907 to collect records of morbidity from poliomyelitis, which in that State have been continued since then. In 1909 more or less incomplete morbidity records were collected by the State authorities in Minnesota, Kansas, and Nebraska, where poliomyelitis was epidemic. With these exceptions no official morbidity records are available prior to 1910, in which year poliomyelitis was declared by the authorities in most States to be a reportable disease. Mortality statistics are therefore available since 1909, and morbidity statistics since 1910, but the data available even since these years are exceedingly incomplete and inaccurate.

The errors and deficiencies encountered in statistics of poliomyelitis are essentially the same as those encountered in the statistics of other infectious diseases, but in extent they are perhaps exceptional. Before presenting the data collected it may be well to discuss briefly their sources of error.

MORBIDITY STATISTICS.

In the morbidity reports of poliomyelitis, as in those of other diseases, the primary error is that due to mistaken diagnosis. It is generally accepted that the well-marked, frankly paralytic cases of poliomyelitis constitute only an indeterminate proportion of the true cases of this disease, yet even the best of morbidity statistics refer only to the clinically well-marked cases, usually those with definite paralysis. Even where attention is sharply directed to this disease, as in severe epidemics, it is probable that quite a large proportion of cases, which in the light of recent clinical knowledge are capable of diagnosis, are overlooked, and there is reason to believe that a goodly proportion of cases can not be diagnosed by any practical means. Where attention is not especially directed toward the disease, the proportion of undiagnosed cases is, of course, greater. Altogether, it is entirely probable that the error due to failure to diagnose cases of poliomyelitis is relatively much greater than in the more familiar infectious diseases, such as scarlet fever, measles, typhoid fever, and diphtheria; and though an improvement in this respect may be anticipated with development of more accurate clinical knowledge, it is not unlikely that this source of error in poliomyelitis statistics will always remain relatively large.

The second error common to all the morbidity statistics in this country arises from the failure on part of practitioners and local health authorities to report all cases recognized. Because of the widespread interest in and alarm occasioned by poliomyelitis within the last few years, it is probable that cases of this disease, when recognized, are more generally reported than are cases of most other infectious diseases. Even so, however, the error due to failure to report known cases is very great; and, what is of more importance, it is extremely variable. In almost any single State reports for different years vary in completeness, the general tendency being to report cases more completely during periods of unusual prevalence and to neglect reporting them at other times. As between different States there is the widest possible variation in completeness of morbidity reports. In a few States a consistent, special effort has been made to collect really reliable morbidity statistics. In many more the reports received represent only a small fraction of the recognized cases, and in not a few States records are wholly lacking, notwithstanding that as a matter of common knowledge the disease prevails. Therefore, since the statistics available from different States for different years are wholly lacking in uniformity, any estimate of the prevalence of poliomyelitis in the United States, and still more, any comparison of its relative prevalence in different States, if based wholly on these incomplete returns, would be not only erroneous but absolutely misleading, tending to create an artificial difference between States with good and those with poor morbidity records.

MORTALITY STATISTICS.

In certain respects statistics of mortality are more reliable than those of morbidity. In the first place, they are probably subject to less initial error in diagnosis, because fatal cases are usually of more pronounced clinical type, and therefore more readily recognized than the milder, nonfatal cases. Nevertheless the diagnostic error in mortality statistics is considerable. Experience in areas intensively studied has shown that a considerable proportion of deaths actually due to poliomyelitis are reported as due to meningitis, pneumonia, and various other causes. So far as may be judged from such experience, the total number of deaths attributed to poliomyelitis is likely to be less than the number actually due to this cause. On the other hand, it is not unlikely that there is some error in the other direction from recording as attributable to poliomyelitis deaths actually due to other causes. In this connection attention may be called to the number and proportion of deaths attributed to poliomyelitis in persons over 60 years of age, as given in the Mortality Statistics of the Census Bureau for the years 1909 to 1914 (Table No. 3).

TABLE NO. 3.—*Number and proportion of deaths from poliomyelitis in persons 60 years of age or over in registration area, United States.*[1]

	Total deaths.	Deaths of persons 60 years of age or over.	
		Number.	Per cent.
1909	569	1	0.175
1910	1,459	14	0.959
1911	1,060	24	2.25
1912	1,138	21	1.84
1913	864	23	2.66
1914	720	25	3.47
Total	5,808	108	1.86

[1] Data from Mortality Statistics, United States Census Bureau, for years 1909–1914.

While it can not be denied that old persons occasionally develop poliomyelitis, and even succumb to the infection, it is likely that at least the great majority of the reported deaths among persons over 60 years of age are attributed to acute anterior poliomyelitis through error in diagnosis.

Mortality statistics, even when complete and accurate, are not a satisfactory index of total prevalence or morbidity, for the obvious reason that the ratio of cases to deaths is not constant. Indeed, so far as may be judged from the most reliable studies, the case fatality of poliomyelitis is extremely variable; much more so, for example, than that of typhoid fever. This is doubtless true even in large groups of cases, as in the total number of cases occurring in the United States in different years; and obviously the irregularity is likely to be greater in smaller groups of cases. Nevertheless, with full cognizance of wide variations in case fatality, and of the statistical irregularities in small figures, it is probable that where deaths are well reported in any large area they give a more reliable index of total prevalence than do the available morbidity reports, which, as stated above, vary so widely in their relation to actual recognized cases.

Unfortunately, even mortality statistics are not uniformly available and reliable in all sections of the United States. In the territory included in the Federal registration area mortality statistics are nearly complete and fairly uniform, so that the data for various subdivisions of this area are properly comparable. In the territory outside of this area statistics are generally incomplete and more or less unreliable, representing only a variable fraction of the deaths actually occurring. The Federal registration area for mortality statistics includes certain States in their entirety; in other States it includes only such communities as have satisfactory registration of deaths under State or local ordinances; and still other States are wholly omitted, having no satisfactory registration. The registration area as established by the Bureau of the Census varies from year to year, additional States and cities being added from time to time as their registration is developed to the required standard, while other communities are dropped if their statistics are found unreliable. The summaries given in Table No. 4 will serve to give a general idea of the relation between the population in the registration area and that of the continental United States in successive years since 1909.

TABLE No. 4.—*Percentage which registration population is of total population in each State and division, by years, 1909–1915.*

	1909	1910	1911	1912	1913	1914	1915
Maine	100	100	100	100	100	100	100
New Hampshire	100	100	100	100	100	100	100
Vermont	100	100	100	100	100	100	100
Massachusetts	100	100	100	100	100	100	100
Rhode Island	100	100	100	100	100	100	100
Connecticut	100	100	100	100	100	100	100
	100	100	100	100	100	100	100
New York	100	100	100	100	100	100	100
New Jersey	100	100	100	100	100	100	100
Pennsylvania	100	100	100	100	100	100	100
	100	100	100	100	100	100	100
Ohio	100	100	100	100	100	100	100
Indiana	100	100	100	100	100	100	100
Illinois	41.3	42.5	43	43	43.5	44	44.2
Michigan	100	100	100	100	100	100	100
Wisconsin	100	100	100	100	100	100	100
	81.8	82.2	82.5	82.5	82.5	82.5	82.6
Minnesota	28.6	100	100	100	100	100	100
Iowa	0	0	0	0	0	0	0
Missouri	30.8	30.8	100	100	100	100	100
North Dakota	0	0	0	0	0	0	0
South Dakota	100	0	0	0	0	0	0
Nebraska	14.1	14.1	14.1	14.2	14.3	14.2	16.6
Kansas	4.7	9.2	9.4	18.7	19.1	100	100
	21	29.4	49	50.2	50.2	62	62.1
Delaware	43	43.2	43.3	43.5	43.7	43.9	44
Maryland	100	100	100	100	100	100	100
District of Columbia	100	100	100	100	100	100	100
Virginia	10.9	13.7	16.3	16.3	100	100	100
West Virginia	3.4	3.4	3.3	3.3	3.3	3.2	0
North Carolina	2	16.4	16.7	17	17.2	20.2	20.5
South Carolina	3.9	3.9	3.9	3.8	3.8	3.8	8.3
Georgia	8.4	8.4	8.9	8.6	10.6	10.7	10.8
Florida	7.7	10.3	10.4	10.5	13.6	13.7	19.7
	19.4	22.6	23	23.1	37.6	38	38.6

TABLE No. 4.—*Percentage which registration population is of total population in each State and division, by years, 1909–1915*—Continued.

	1909	1910	1911	1912	1913	1914	1915
Kentucky	13.4	14.5	100	100	100	100	100
Tennessee	12.7	12.7	12.8	12.9	12.3	16.5	16.6
Alabama	10.4	10.5	10.8	11	11.3	11.6	11.9
Mississippi	0	0	0	0	0	0	0
	9.6	9.9	33.2	33.1	32.9	34.5	35.1
Arkansas	0	0	0	0	0	0	0
Louisiana	20.2	20.4	20.2	20.2	20.2	20.3	20.3
Oklahoma	0	0	0	0	0	0	0
Texas	3.4	3.4	4.6	4.1	4.8	5	5.1
	5.4	5.4	5.8	5.7	5.8	5.9	5.9
Montana	0	100	100	100	100	100	100
Idaho	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0
Colorado	100	100	100	100	100	100	100
New Mexico	0	0	0	0	0	0	0
Arizona	0	0	0	0	0	0	0
Utah	24.8	100	100	100	100	100	100
Nevada	0	0	0	0	0	0	0
	33.9	59	58.5	58.2	57.8	57.7	58.8
Washington	100	100	100	100	100	100	100
Oregon	30.8	30.8	31.6	32.1	32.6	33.2	33.7
California	100	100	100	100	100	100	100
	89	89	89	89.3	89.3	89.5	89.6
United States	56.1	58.2	63.2	63.2	65.2	65.8	67

REPORTED DEATHS AND CASES IN THE UNITED STATES, BY STATES AND DIVISIONS, 1909 TO 1915.

In Tables Nos. 5 to 11 the attempt has been made to utilize all the data available regarding the prevalence of poliomyelitis, both mortality and morbidity statistics. In such a summary the deficiencies of the statistics for certain areas are quite obvious.

TABLE No. 5.—*Poliomyelitis in United States, 1909—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Maine	6	....	6	Deaths only.
New Hampshire	11	....	11	Do.
Vermont	2	....	2	Do.
Massachusetts	62	....	923	Report to Public Health Service.
Rhode Island	4	....	4	Deaths only.
Connecticut	6	....	6	Do.
New England States: Total	91	....	952	
New York	115	....	115	Do.
New Jersey	24	....	24	Do.
Pennsylvania	76	....	76	Do.
Middle Atlantic States: Total	215	....	215	

TABLE No. 5.—*Poliomyelitis in United States, 1909—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Ohio	16	....	16	Deaths only.
Indiana	14	....	14	Do.
Illinois	[1] 19	....	19	Do.
Michigan	16	....	16	Do.
Wisconsin	51	....	51	Do.
East North Central States: Total.	116	....	116	
Minnesota	[1] 82	152	900	Report to Public Health Service.
Iowa	(2)	....	....	No records.
Missouri	[1] 5	....	5	Deaths only.
North Dakota	(2)	25	75	Manning.
South Dakota	6	....	6	Deaths only.
Nebraska	8	125	1,000	McClanahan.
Kansas	[1] 0	18	105	Report to Public Health Service.
West North Central States: Total.	101	320	2,091	
Delaware	[1] 0	....	....	
Maryland	4	....	4	Deaths only.
District of Columbia	1	....	1	Do.
Virginia	[1] 3	....	3	Do.
West Virginia	[1] 0	....	....	Do.
North Carolina	[1] 1	....	1	Do.
South Carolina	[1] 1	....	1	Do.
Georgia	[1] 0	....	....	
Florida	[1] 0	....	....	
South Atlantic States: Total	10	....	10	
Kentucky	[1] 2	....	2	Do.
Tennessee	[1] 1	....	1	Do.
Alabama	[1] 2	....	2	Do.
Mississippi	(2)	....	....	
East South Central States: Total.	5	....	5	
Arkansas	(2)	....	....	
Louisiana	[1] 1	....	1	Do.
Oklahoma	(2)	....	....	
Texas	[1] 2	....	2	Do.
West South Central States: Total.	3	....	3	
Montana	(2)	....	....	
Idaho	(2)	....	(2)	
Wyoming	(2)	....	(2)	
Colorado	6	....	6	Do.
New Mexico	(2)	....	....	
Arizona	(2)	....	....	
Utah	[1] 3	....	3	Do.
Nevada	(2)	....	(2)	
Mountain States: Total	9	....	9	
Washington	5	....	5	Do.
Oregon	[1] 2	....	2	Do.
California	12	....	67	Fleischner.
Pacific States: Total	19	....	74	
United States: Total	569	320	3,475	

---

[1] Registration only in certain cities in State.

[2] No registration.

TABLE NO. 6.—*Poliomyelitis in United States, 1910—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Maine	31	....	31	Deaths only.
New Hampshire	19	....	19	Do.
Vermont	9	....	69	Report to Public Health Service.
Massachusetts	122	....	845	Do.
Rhode Island	44	....	231	Do.
Connecticut	40	....	168	Do.
New England States: Total	265	....	1,363	
New York	170	....	322	Frost.
New Jersey	50	....	75	Report to Public Health Service.
Pennsylvania	269	....	1,112	Do.
Middle Atlantic States: Total	489	....	1,509	
Ohio	76	....	76	Deaths only.
Indiana	49	....	133	Report to Public Health Service.
Illinois	[1] 24	53	137	Do.
Michigan	48	....	104	Do.
Wisconsin	43	....	43	Deaths only.
East North Central States: Total	240	53	493	
Minnesota	197	....	631	Report to Public Health Service.
Iowa	(2)	146	654	Frost.
Missouri	[1] 18	....	309	O'Rielly.
North Dakota	(2)	....	100	Report to Public Health Service.
South Dakota	(2)	....	86	Do.
Nebraska	[1] 4	....	144	Manning.
Kansas	[1] 4	....	189	Report to Public Health Service.
West North Central States: Total	223	146	2,113	
Delaware	[1] 3	....	3	Deaths only.
Maryland	35	....	35	Do.
District of Columbia	21	....	139	Report to Public Health Service.
Virginia	[1] 15	....	357	Do.
West Virginia	(1)	....	....	
North Carolina	[1] 3	....	3	Deaths only.
South Carolina	[1] 1	....	85	Report to Public Health Service.
Georgia	(1)	....	....	
Florida	(1)	....	21	Do.
South Atlantic States: Total	78	....	643	
Kentucky	[1] 1	....	1	Deaths only.
Tennessee	[1] 1	....	1	Do.
Alabama	[1] 3	....	15	Report to Public Health Service.
Mississippi	(2)	....	....	
East South Central States: Total	5	....	17	
Arkansas	(2)	....	....	
Louisiana	[1] 2	....	2	Deaths only.
Oklahoma	(2)	....	5	Report to Public Health Service.
Texas	(1)	....	....	
West South Central States: Total	2	....	7	
Montana	17	....	40	Report to Public Health Service.
Idaho	(2)	11	97	Do.
Wyoming	(2)	....	....	

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 6.—*Poliomyelitis in United States, 1910—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Colorado	4		5	Report to Public Health Service.
New Mexico	(1)			
Arizona	(1)			
Utah	7		7	Deaths only.
Nevada	(1)		9	
Mountain States: Total	28	11	158	
Washington	81		397	Report to Public Health Service.
Oregon	[2] 19	35	112	Washington State Board of Health.
California	29		139	Fleischner.
Pacific States: Total	129	35	648	
United States: Total	1,459	245	6,951	

[1] No registration. [2] Registration only in certain cities in State.

TABLE No. 7.—*Poliomyelitis in United States, 1911—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States Census registration area.	Additional State records.	Number.	Source of data.
Maine	13		13	Deaths only.
New Hampshire	11		11	Do.
Vermont	11		27	Report to Public Health Service.
Massachusetts	55		260	Do.
Rhode Island	14		14	Deaths only.
Connecticut	15		45	Report to Public Health Service.
New England States: Total	119		370	
New York	166		485	Do.
New Jersey	46		47	Do.
Pennsylvania	93		177	Do.
Middle Atlantic States: Total	305		709	
Ohio	137		137	Deaths only.
Indiana	69.		97	Report to Public Health Service.
Illinois	[1]16	76	141	Do.
Michigan	46		68	Do.
Wisconsin	31		56	Do.
East North Central States: Total	299	76	499	
Minnesota	59		117	Do.
Iowa	(2)	40	70	Do.
Missouri	60		60	Deaths only.
North Dakota	(2)		11	Report to Public Health Service.
South Dakota	(2)		26	Do.
Nebraska	[1]2		2	Deaths only.
Kansas	[1]4		4	Do.
West North Central States: Total	125	40	290	

TABLE No. 7.—*Poliomyelitis in United States, 1911—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Delaware	[1]2	....	2	Deaths only.
Maryland	34	....	34	Do.
District of Columbia	5	....	7	Report to Public Health Service.
Virginia	[1]6	....	332	Do.
West Virginia	[1]1	....	1	Deaths only.
North Carolina	[1]15	....	15	Do.
South Carolina	[1]1	....	2	Report to Public Health Service.
Georgia	[1]3	....	3	Deaths only.
Florida	[1]0	1	31	Report to Public Health Service.
South Atlantic States: Total	67	1	433	
Kentucky	61	....	61	Deaths only.
Tennessee	[1]3	....	3	Do.
Alabama	[1]11	3	14	Deaths only; State records.
Mississippi	(2)	....	....	
East South Central States: Total	75	3	78	
Arkansas	(2)	....	25	Report to Public Health Service.
Louisiana	[1]3	12	60	Patterson.
Oklahoma	(2)	....	....	
Texas	[1]3	....	3	Deaths only.
West South Central States: Total	6	12	88	
Montana	5	....	5	Do.
Idaho	(2)	....	13	Report to Public Health Service.
Wyoming	(2)	....	....	
Colorado	6	....	6	Deaths only.
New Mexico	(2)	....	....	
Arizona	(2)	....	....	
Utah	3	....	3	Do.
Nevada	(2)	....	....	
Mountain States: Total	14	....	27	
Washington	19	....	38	Report to Public Health Service.
Oregon	[1]0	11	11	Deaths; report to Public Health Service.
California	31	....	55	Gundrum.
Pacific States: Total	50	11	104	
United States: Total	1,060	143	2,598	

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 8.—*Poliomyelitis in United States, 1912—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States Census registration area.	Additional State records.	Number.	Source of data.
Maine	9		9	Deaths only.
New Hampshire	8		8	Do.
Vermont	9		13	Report to Public Health Service.
Massachusetts	50		169	Do.
Rhode Island	7		7	Deaths only.
Connecticut	9		31	Report to Public Health Service.
New England States: Total	92		237	
New York	224		1,108	Do.
New Jersey	27		44	Do.
Pennsylvania	116		267	Dixon.
Middle Atlantic States: Total	367		1,419	
Ohio	176		354	Boudreu aand Brain.
Indiana	46		92	Report to Public Health Service.
Illinois	[1] 26	32	480	Do.
Michigan	42		78	Do.
Wisconsin	32		54	Do.
East North Central States: Total.	322	32	1,058	
Minnesota	28		43	Do.
Iowa	(2)	38	77	Do.
Missouri	76		76	Deaths only.
North Dakota	(2)			
South Dakota	(2)			
Nebraska	[1] 3		3	Do.
Kansas	[1] 6		72	
West North Central States: Total.	113	38	271	
Delaware	[1] 1		1	Do.
Maryland	31		57	Report to Public Health Service.
District of Columbia	4		10	Do.
Virginia	[1] 1	18	229	Do.
West Virginia	[1] 0			Deaths only.
North Carolina	[1] 3		3	Do.
South Carolina	[1] 1		20	Report to Public Health Service.
Georgia	[1] 5		5	Deaths only.
Florida	[1] 1		1	Do.
South Atlantic States: Total	47	18	326	
Kentucky	37		37	Do.
Tennessee	[1] 3		3	Do.
Alabama	[1] 2	23	25	Do.
Mississippi	(2)			
East South Central States: Total.	42	23	65	
Arkansas	(2)			
Louisiana	[1] 1		1	Do.
Oklahoma	(2)		14	Report to Public Health Service.
Texas	[1] 2		2	Deaths only.
West South Central States: Total.	3		17	
Montana	11		11	Do.
Idaho	(2)			
Wyoming	(2)			
Colorado	4		4	Do.
New Mexico	(2)			Do.

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 8.—*Poliomyelitis in United States, 1912—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Arizona	(1)			Deaths only.
Utah	6		6	Do.
Nevada	(1)		3	Report to Public Health Service.
Mountain States: Total	21		24	
Washington	7		16	Do.
Oregon	[2]3	2	6	Do.
California	119		531	Do.
Pacific States: Total	129	2	553	
United States: Total	1,136	113	3,970	

[1] No registration.

[2] Registration only in certain cities in State.

TABLE No. 9.—*Poliomyelitis in United States, 1913—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Maine	14		21	Report to Public Health Service.
New Hampshire	21		21	Deaths only.
Vermont	6		47	Report to Public Health Service.
Massachusetts	67		362	Do.
Rhode Island	13		71	Do.
Connecticut	9		29	Do.
New England States: Total	130		551	
New York	136		491	Do.
New Jersey	30		87	Do.
Pennsylvania	96		141	Dixon
Middle Atlantic States: Total	262		719	
Ohio	62		125	Report to Public Health Service.
Indiana	45		104	Do.
Illinois	[1]7	18	126	Do.
Michigan	41		56	Do.
Wisconsin	30		74	Do.
East North Central States: Total	185	18	485	
Minnesota	36		90	Do.
Iowa	(2)	28	57	Do.
Missouri	48		48	Deaths only.
North Dakota	(2)			
South Dakota	(2)	2	7	Report to Public Health Service.
Nebraska	[1]2		5	Do.
Kansas	[1]4		90	Do.
West North Central States: Total	90	30	297	
Delaware	[1]1		1	Deaths only.
Maryland	19		19	Do.
District of Columbia	2		5	Report to Public Health Service.

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 9.—*Poliomyelitis in United States, 1913—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Virginia	44		246	Report to Public Health Service.
West Virginia	[1] 0			
North Carolina	[1] 7		7	Deaths only.
South Carolina	[1] 1		31	Report to Public Health Service.
Georgia	[1] 1		1	Deaths only.
Florida	[1] 3		3	Do.
South Atlantic States: Total	78		573	
Kentucky	52		52	Report to Public Health Service.
Tennessee	[1] 3		3	Deaths only.
Alabama	[1] 4	20	20	Do.
Mississippi	(2)		69	Report to Public Health Service.
East South Central States: Total	59	20	144	
Arkansas	(2)		143	Francis.
Louisiana	(2)			Deaths only.
Oklahoma	(2)			
Texas	[1] 2		2	Do.
West South Central States: Total	2		145	
Montana	8		9	Report to Public Health Service.
Idaho	(2)	4	10	Do.
Wyoming	(2)			
Colorado	1		1	Deaths only.
New Mexico	(2)			
Arizona	(2)		1	Report to Public Health Service.
Utah	7		7	Deaths only.
Nevada	(2)	2	8	Report State Board of Health.
Mountain States: Total	16	6	36	
Washington	11		19	Report to Public Health Service.
Oregon	2	3	5	Do.
California	29		92	
Pacific States: Total	42	3	116	
United States: Total	864	77	3,066	

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 10.—*Poliomyelitis in United States, 1914—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Maine	8	...	8	Deaths only.
New Hampshire	9	...	9	Do.
Vermont	54	...	306	Report to Public Health Service.
Massachusetts	50	...	151	Do.
Rhode Island	9	...	9	Deaths only.
Connecticut	6	...	13	Report to Public Health Service.
New England States: Total	136	...	496	
New York	88	...	224	Do.
New Jersey	19	...	35	Do.
Pennsylvania	65	...	113	Dixon.
Middle Atlantic States: Total	172	...	372	
Ohio	58	...	63	Report to Public Health Service.
Indiana	33	...	52	Do.
Illinois	[1] 24	2	142	Do.
Michigan	34	...	49	Do.
Wisconsin	20	...	31	Do.
East North Central States: Total	169	2	337	
Minnesota	15	...	32	Do.
Iowa	(2)	16	19	Do.
Missouri	38	...	38	Deaths only.
North Dakota	(2)	...	...	
South Dakota	(2)	1	5	Report to Public Health Service.
Nebraska	[1] 2	...	2	Deaths only.
Kansas	13	...	25	Report to Public Health Service.
West North Central States: Total	68	17	121	
Delaware	[1] 1	...	1	Deaths only.
Maryland	15	...	15	Do.
District of Columbia	1	...	8	Do.
Virginia	42	...	151	Do.
West Virginia	(1)	...	...	
North Carolina	12	...	12	Do.
South Carolina	[1] 1	...	21	Report to Public Health Service.
Georgia	[1] 3	...	3	Deaths only.
Florida	[1] 1	...	1	Do.
South Atlantic States: Total	76	...	212	
Kentucky	27	...	27	Do.
Tennessee	[1] 5	...	51	Report to Public Health Service.
Alabama	[1] 5	12	17	Deaths only.
Mississippi	(2)	1	113	Report to Public Health Service.
East South Central States: Total	37	13	208	
Arkansas	(2)	...	7	Do.
Louisiana	1	...	9	Do.
Oklahoma	(2)	...	...	
Texas	(1)	...	...	
West South Central States: Total	1	...	16	
Montana	4	...	4	Deaths only.
Idaho	(2)	1	1	Do.
Wyoming	(2)	...	...	
Colorado	8	...	8	Do.
New Mexico	(2)	...	...	

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 10.—*Poliomyelitis in United States, 1914—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Arizona	(1)	1	1	Deaths only.
Utah	5		5	Do.
Nevada	(1)	2	4	Report to Public Health Service.
Mountain States: Total	17	4	23	
Washington	11		21	Do.
Oregon	(2)			
California	33		56	Do.
Pacific States: Total	44		77	
United States: Total	720	36	1,862	

[1] No registration.

[2] Registration only in certain cities in State.

TABLE No. 11.—*Poliomyelitis in United States, 1915—Reported deaths and cases, by States and divisions.*

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
Maine	6		10	Report to Public Health Service.
New Hampshire	9		9	Deaths only.
Vermont	18		44	Report to Public Health Service.
Massachusetts	41		135	Do.
Rhode Island	7		27	Do.
Connecticut	12		43	Do.
New England States: Total	93		268	
New York	70		257	Do.
New Jersey	24		36	Do.
Pennsylvania	85		162	Dixon.
Middle Atlantic States: Total	179		455	
Ohio	95		466	Report to Public Health Service.
Indiana	19		43	Do.
Illinois	[1] 16		81	Do.
Michigan	35		94	Do.
Wisconsin	13		14	Do.
East North Central States: Total	178		698	
Minnesota	30		127	Do.
Iowa	(2)	19	19	Deaths only.
Missouri	40		40	Do.
North Dakota	(2)			
South Dakota	(2)	3	12	Report to Public Health Service.
Nebraska	(1)			
Kansas	20		48	Do.
West North Central States: Total	90	22	246	
Delaware	[1] 3		3	Deaths only.
Maryland	21		66	Report to Public Health Service.

[1] Registration only in certain cities in State.

[2] No registration.

TABLE No. 11.—*Poliomyelitis in United States, 1915—Reported deaths and cases, by States and divisions*—Continued.

States and divisions.	Deaths.		Cases reported.	
	United States census registration area.	Additional State records.	Number.	Source of data.
District of Columbia	4	....	6	Report to Public Health Service.
Virginia	37	....	241	Do.
West Virginia	(1)	....	....	
North Carolina	[1] 6	....	17	Do.
South Carolina	[1] 1	2	3	Deaths only.
Georgia	[1] 4	....	4	Do.
Florida	[1] 1	....	1	Do.
South Atlantic States: Total	77	2	341	
Kentucky	23	....	23	Do.
Tennessee	[1] 6	....	38	Report to Public Health Service.
Alabama	[1] 2	16	18	Deaths only.
Mississippi	(1)	3	85	Report to Public Health Service.
East South Central States: Total	31	19	164	
Arkansas	(2)	....	12	Do.
Louisiana	(1)	....	12	Do.
Oklahoma	(2)	....	....	
Texas	[1] 3	....	8	Do.
West South Central States: Total	3	....	32	
Montana	1	....	3	Do.
Idaho	(2)	....	....	
Wyoming	(2)	....	....	
Colorado	6	....	6	Deaths only.
New Mexico	(2)	....	....	
Arizona	(2)	....	2	Report to Public Health Service.
Utah	3	....	3	Deaths only.
Nevada	(2)	2	3	Report to Public Health Service.
Mountain States: Total	10	2	17	
Washington	7	....	10	Do.
Oregon	(1)	....	1	Do.
California	23	....	62	Do.
Pacific States: Total	30	....	73	
United States: Total	691	45	2,294	

[1] Registration only in certain cities in state.

[2] No registration.

A brief discussion of the foregoing tables is given herewith. The deaths in the registration area of each State are recorded as given in the Mortality Statistics of the Census Bureau. For States entirely within the registration area minor differences between the figures given in State records and those of the Census Bureau are disregarded, the census figures being uniformly taken as the standard. In a number of States which are only partially included in the Federal registration area more or less complete mortality records are available from State registrars. In such instances the difference between the total number of deaths as given in State records and those given in the census records is recorded under the heading of "Additional deaths, State records."

Under the heading "Cases reported" in these tables preference is given to the official reports rendered by State health authorities to the Surgeon General of the Public Health Service, data being taken from their annual reports as summarized in various issues of the Public Health Reports or from special reports rendered during the year 1916, summarizing for each State morbidity records for all years since 1909. Where the reports received in 1916 do not agree with those received in previous years from the same sources, preference has uniformly been given to the reports citing the largest number of cases.

In certain instances the figures used are taken, not from official records, but from reliable reports of special studies citing a well-authenticated number of cases in excess of those officially reported. In such instances the source of information is cited in the tables.

Where no cases are reported, or where their number is less than that of the deaths recorded, a number of cases equal to the number of deaths has been put down as representing certainly the minimum of authentic cases.

From the data given in detail in these tables, which are presented chiefly as base tables, a summary of annual death rates by States for the years 1909 to 1915 has been prepared, using, for each registration State and for the registration portions of those States not wholly in the registration area, the population estimates given by the United States Census Bureau in Bulletin No. 133.

TABLE NO. 12.—*Poliomyelitis—Death rates by States, 1909–1915.*

States.	Death rates per 100,000 from poliomyelitis in registration area in each State.						
	1909	1910	1911	1912	1913	1914	1915
Maine	0.8	4.2	1.7	1.2	1.8	1.0	0.8
New Hampshire	2.6	4.4	2.5	1.8	4.8	2.1	2.0
Vermont	0.6	2.5	3.1	2.5	1.7	15.0	5.0
Massachusetts	1.8	3.6	1.6	1.4	1.9	1.4	1.1
Rhode Island	0.7	8.1	2.5	1.2	2.2	1.5	1.2
Connecticut	0.5	3.6	1.3	0.8	0.8	0.5	1.0
New York	1.3	1.9	1.8	2.4	1.4	0.9	0.7
New Jersey	0.9	2.0	1.8	1.0	1.1	0.7	0.8
Pennsylvania	1.0	3.5	1.2	1.5	1.2	0.8	1.0
Ohio	0.3	1.6	2.8	3.6	1.2	1.2	1.9
Indiana	0.5	1.8	2.5	1.7	1.6	1.2	0.7
Illinois	[1] 0.8	[1] 1.0	[1] 0.7	[1] 1.0	[1] 0.3	[1] 0.9	[1] 0.6
Michigan	0.6	1.7	1.6	1.4	1.4	1.1	1.2
Wisconsin	2.2	1.8	1.3	1.3	1.2	0.8	0.5
Minnesota	11.3	9.5	2.8	1.3	1.7	0.7	1.3
Iowa	(2)	[3] 6.6	[3] 1.8	[3] 1.7	[3] 1.3	[3] 0.7	[3] 0.8
Missouri	[1] 0.5	[1] 1.8	1.8	2.8	1.4	1.1	1.2
North Dakota	(2)	(2)	(2)	(2)	(2)	(2)	(2)
South Dakota	1.0						
Nebraska	[1] 4.8	[1] 2.4	[1] 1.2	[1] 1.7	[1] 1.1	[1] 1.1	[1] 0
Kansas	[1] 0	[1] 2.6	[1] 2.5	[1] 1.8	[1] 1.2	0.7	1.1

[1] Registration in certain cities of State. [2] No registration. [3] State records only.

TABLE No. 12.—*Poliomyelitis—Death rates by States, 1909–1915*—Continued.

States.	Death rates per 100,000 from poliomyelitis in registration area in each State.						
	1909	1910	1911	1912	1913	1914	1915
Delaware	[1] 0	3.4	2.2	[1] 1.1	[1] 1.1	[1] 1.1	[1] 3.2
Maryland	0.3	2.7	2.6	2.3	1.4	1.1	1.6
District of Columbia	0.3	6.3	1.5	1.2	0.6	0.3	1.1
Virginia	[1] 1.3	[1] 5.3	[1] 1.8	[1] 0.3	2.1	2.0	1.7
West Virginia	[1] 0	[1] 0	[1] 2.4	[1] 0	[1] 0	[1] 0	[1] 0
North Carolina	[1] 2.2	[1] 0.8	[1] 4.0	[1] 0.8	[1] 1.8	[1] 2.5	[1] 1.2
South Carolina	[1] 1.7	[1] 1.7	[1] 1.7	[1] 1.7	[1] 1.7	[1] 1.7	[1] 0.8
Georgia	[1] 0	[1] 0	[1] 1.3	[1] 2.1	[1] 0.3	[1] 1.0	[1] 1.3
Florida	[1] 0	[1] 0	[1] 0	[1] 1.2	[1] 2.7	[1] 0.9	[1] 0.6
Kentucky	[1] 0.7	[1] 0.3	2.6	1.6	2.2	1.1	1.0
Tennessee	[1] 0.4	[1] 0.4	[1] 1.1	[1] 1.0	[1] 1.1	[1] 1.3	[1] 1.6
Alabama	[1] 0.4	[1] 1.3	[1] 4.7	[1] 0.8	[1] 1.6	[1] 1.9	[1] 0.7
Mississippi	(2)	(2)	(2)	(2)	(2)	(2)	[1] 0
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Louisiana	[1] 0.3	[1] 0.6	[1] 0.9	[1] 0.3	[1] 0	[1] 0.3	[1] 0
Oklahoma	(2)	(2)	(2)	(2)	(2)	(2)	(1)
Texas	[1] 1.0	[1] 0	[1] 1.6	[1] 1.1	[1] 1.0	[1] 0	[1] 1.4
Montana	(1)	4.5	1.3	2.7	1.9	0.9	0.2
Idaho	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Wyoming	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Colorado	0.8	0.5	0.7	0.5	0.1	0.9	0.6
New Mexico	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Arizona	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Utah	[1] 3.2	1.9	0.8	1.5	1.7	1.2	0.7
Nevada	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	0.4	7.0	1.6	0.5	0.8	0.8	0.5
Oregon	[1] 1.0	[1] 9.1	[1] 0	[1] 1.3	[1] 0.8	[1] 0	[1] 0
California	0.5	1.2	1.2	4.6	1.1	1.2	0.8

[1] Registration in certain cities of State. [2] No registration. [3] State records only.

PREVALENCE OF POLIOMYELITIS: DEATHS AND CASES, REPORTED AND ESTIMATED, IN PRINCIPAL GEOGRAPHIC DIVISIONS OF THE UNITED STATES, 1909 TO 1915.

In Tables 13 to 19, inclusive, the data presented in the foregoing series are summarized by main divisions, each of which includes a group of States, and are supplemented by estimates of additional deaths and cases.

The following explanatory notes refer to all of the tables from 13 to 19:

Registration area: As given in Mortality Statistics, United States Census Bureau, each year.

Population: Total, as given in Estimates of Population, 1910–1916, Bulletin No. 133, United States Census Bureau. Population in registration area, in divisions not wholly within registration area, obtained by summation of registration population of individual States as given in Mortality Statistics for corresponding year.

Deaths in registration area: As given in Mortality Statistics for corresponding year.

Deaths in total area: Estimated by applying same death rate as shown in registration population of each division to total population. In some instances, specifically designated, deaths reported by State registrars from territory not in Federal registration area are added to deaths reported from registration area, and this total is used if it exceeds the estimated total.

Cases reported: As given in reports rendered by State authorities to Public Health Service, either usual reports to Surgeon General or special reports to local office of Public Health Service in New York. Where both reports are available, the one giving the greater number of cases is taken. Where these reports are obviously deficient, unofficial figures compiled by reliable special investigators, usually working in cooperation with health authorities, have been taken.

Cases estimated: Taken as five times the number of deaths reported or estimated in each division, except that when number of cases reported approximates or exceeds this estimate the reported cases are given preference.

TABLE No. 13.—*Prevalence of poliomyelitis in the United States, 1909*[1]*—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population (United States Census, Apr. 15, 1910).	Deaths from poliomyelitis.		Population (United States Census, Apr. 15, 1910).	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,552,681	91	1.39	6,552,681	91	952	14.5	[2] 1,100	16.8
Middle Atlantic States	19,315,892	215	1.11	19,315,892	215	215	1.1	[3] 1,075	[3] 5.5
East North Central States	14,936,507	116	0.78	18,250,621	141	116	0.6	705	3.9
West North Central States	2,441,719	101	4.14	11,637,921	[4] 481	2,090	17.9	2,400	20.6
South Atlantic States	2,361,442	10	0.42	12,194,895	52	10	0.1	260	2.1
East South Central States	807,664	5	0.62	8,409,901	52	5	([5])	260	3.1
West South Central States	472,670	3	0.63	8,784,534	56	3	([5])	280	3.2
Mountain States	891,801	9	1.01	2,633,517	26	9	0.3	130	4.9
Pacific States	3,726,753	19	0.51	4,192,304	21	74	1.8	105	2.5
United States: Total	51,507,129	569	1.17	91,972,266	1,135	3,474	3.8	6,315	6.9

---

[1] Populations used are those of the 1910 census enumeration, not mid-year estimates.

[2] Estimate made by adding to the cases reported in Massachusetts (923), five times the number of deaths (29) reported from remainder of territory. If case fatality in Massachusetts (6.7 per cent) be assumed for remainder of territory, the indicated total cases in New England States is 1,350.

[3] This figure is probably far too small, as it is likely that the cases in this division greatly exceeded those in New England.

[4] In addition to 101 deaths reported in registration territory, 320 deaths were reported in nonregistration territory in Minnesota, North Dakota, Nebraska, and Kansas, making a total of 421 deaths recorded in about 61 per cent of the population of this division.

[5] Less than 0.1 per 100,000.

TABLE No. 14.—*Prevalence of poliomyelitis in the United States, 1910—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1910.	Deaths from poliomyelitis.		Population, estimated, July 1, 1910.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,572,948	265	4.03	6,572,948	265	1,363	20.7	1,363	20.7
Middle Atlantic States	19,397,352	489	2.52	19,397,352	489	1,509	7.8	2,445	12.6
East North Central States	15,049,822	240	1.59	18,298,406	[1] 293	493	2.7	1,465	8.0
West North Central States	3,424,056	223	6.51	11,665,145	[2] 759	2,482	21.3	3,795	32.5
South Atlantic States	2,763,327	78	2.82	12,231,847	345	643	5.2	1,725	14.1
East South Central States	835,219	5	.60	8,428,089	50	17	.2	250	3.0
West South Central States	474,842	2	.42	8,832,049	37	7	.1	185	2.1
Mountain States	1,558,738	28	1.80	2,653,747	47	158	6.0	235	8.9
Pacific States	3,761,250	129	3.43	4,229,765	[3] 164	648	15.3	820	19.4
United States: Total	53,837,554	1,459	2.71	92,309,348	2,449	7,320	7.9	12,283	13.3

[1] Additional deaths reported from nonregistration territory (in Illinois) give same total as estimate, 293.

[2] Additional deaths reported from nonregistration territory (in Iowa, 146), make total of 369 deaths reported in 48.5 per cent of the total population. An estimate based on this ratio gives 780 cases.

[3] Additional deaths (35) reported from nonregistration territory in Oregon make up a total of 161, which is used, being in excess of the estimated number (145).

TABLE No. 15.—*Prevalence of poliomyelitis in United States, 1911—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1911.	Deaths from poliomyelitis.		Population, estimated, July 1, 1911.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,670,231	119	1.78	6,670,231	119	370	5.5	595	8.9
Middle Atlantic States	19,788,361	305	1.54	19,788,361	305	709	3.6	1,525	7.7
East North Central States	15,250,687	299	1.96	18,527,778	[1] 375	499	2.7	1,875	10.1
West North Central States	5,764,434	125	2.17	11,795,830	256	290	2.4	1,280	11.5
South Atlantic States	2,856,254	67	2.35	12,409,204	291	433	3.5	1,455	11.7
East South Central States	2,824,433	75	2.66	8,515,395	226	78	0.9	1,180	13.9
West South Central States	529,307	6	1.13	9,060,124	102	88	1.0	510	5.6
Mountain States	1,608,221	14	0.87	2,750,846	24	27	1.0	135	4.9
Pacific States	3,927,530	50	1.27	4,409,573	[2] 61	104	2.4	305	6.9
United States: Total	59,219,460	1,060	1.8	93,927,342	1,762	2,598	2.7	8,860	9.4

[1] Additional deaths reported (76) from nonregistration territory (in Illinois) make total of 375. Estimated total would be 363.

[2] Additional deaths reported (11) from nonregistration territory (in Oregon) make total of 61. Estimated total would be 56.

TABLE No. 16.—*Prevalence of poliomyelitis in United States, 1912—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1912.	Deaths from poliomyelitis.		Population, estimated, July 1, 1912.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,767,513	92	1.36	6,767,513	92	237	3.5	460	6.8
Middle Atlantic States	20,179,371	367	1.82	20,179,371	367	1,419	7.0	1,835	9.1
East North Central States	15,452,220	322	2.08	18,757,149	301	1,058	5.6	1,955	10.4
West North Central States	5,983,450	113	1.89	11,926,573	225	271	2.3	1,225	10.3
South Atlantic States	2,900,450	47	1.62	12,586,562	204	326	2.6	1,020	8.1
East South Central States	2,852,879	42	1.47	8,602,701	127	65	0.8	635	7.4
West South Central States	540,351	3	0.56	9,288,200	52	17	0.2	260	2.8
Mountain States	1,657,703	21	1.27	2,847,946	36	24	0.8	180	6.3
Pacific States	4,093,181	129	2.19	4,589,381	131	553	12.0	655	14.3
United States: Total.	60,427,237	1,136	1.88	95,545,336	1,625	3,970	4.2	8,125	8.5

TABLE No. 17.—*Prevalence of poliomyelitis in United States, 1913—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1913.	Deaths from poliomyelitis.		Population, estimated, July 1, 1913.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,864,796	130	1.89	6,864,796	130	551	8.0	650	9.5
Middle Atlantic States	20,570,382	262	1.27	20,570,382	262	719	3.5	1,310	6.4
East North Central States	15,652,299	185	1.18	18,986,520	224	485	2.6	1,120	5.9
West North Central States	6,047,714	90	1.49	12,057,197	179	297	2.5	895	7.4
South Atlantic States	4,800,518	78	1.62	12,763,921	207	573	4.5	1,035	8.1
East South Central States	2,864,284	59	2.06	8,690,008	179	144	1.7	895	10.3
West South Central States	558,041	2	0.36	9,516,275	34	145	1.5	170	1.8
Mountain States	1,707,185	16	0.94	2,945,043	28	36	1.2	140	4.7
Pacific States	4,258,771	42	0.99	4,769,190	47	116	2.4	235	4.9
United States: Total.	62,323,999	864	1.4	97,163,330	1,290	3,066	3.2	6,450	6.6

TABLE No. 18.—*Prevalence of poliomyelitis in United States, 1914—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1914.	Deaths from poliomyelitis.		Population, estimated, July 1, 1914.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	6,962,079	136	1.97	6,962,079	136	446	7.2	680	9.8
Middle Atlantic States	20,961,391	172	0.82	20,961,391	172	372	1.8	860	4.1
East North Central States	15,856,254	169	1.07	19,215,892	205	337	1.8	1,025	5.3
West North Central States	7,548,438	68	0.90	12,187,879	110	121	1.0	550	4.5
South Atlantic States	4,924,947	76	1.54	12,941,280	200	212	1.6	1,000	7.7
East South Central States	2,984,897	37	1.24	8,777,312	109	208	2.4	545	6.2
West South Central States	572,409	1	0.17	9,744,350	17	16	0.2	85	0.8
Mountain States	1,756,669	17	0.97	3,042,142	29	23	0.7	145	4.8
Pacific States	4,426,361	44	0.99	4,948,999	49	77	1.6	245	4.9
United States: Total	65,993,445	720	1.09	98,781,324	1,027	1,862	1.9	5,035	5.1

TABLE No. 19.—*Prevalence of poliomyelitis in United States, 1915—Cases and deaths, reported and estimated, by principal geographic divisions.*

Divisions.	Registration area.			Total area.					
	Population, estimated, July 1, 1915.	Deaths from poliomyelitis.		Population, estimated, July 1, 1915.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
New England States	7,059,361	93	1.32	7,059,361	93	268	3.8	465	6.6
Middle Atlantic States	21,352,400	179	0.84	21,352,400	179	455	2.1	895	4.2
East North Central States	16,058,722	178	1.11	19,445,263	215	698	3.6	1,075	5.5
West North Central States	7,654,999	90	1.17	12,318,562	145	246	2.0	725	5.9
South Atlantic States	5,069,206	77	1.52	13,118,637	199	341	2.6	995	7.5
East South Central States	3,115,141	31	1.00	8,864,619	88	164	1.8	440	5.0
West South Central States	586,778	3	0.51	9,972,425	51	32	0.3	255	2.6
Mountain States	1,806,153	10	0.55	3,139,243	17	17	0.5	85	2.7
Pacific States	4,592,151	30	0.65	5,128,808	33	73	1.4	165	3.2
United States: Total	67,292,911	691	1.0	100,399,318	1,020	2,294	2.3	5,100	5.1

In each division not wholly included within the registration area the death rate obtaining in the registration population is assumed to have obtained in the whole population of that division, and the corresponding number of deaths in the total population has been estimated by simple proportion. Where exceptions are made to this rule, they are, in each instance, mentioned in footnotes appended to the several tables.

A probable number of cases occurring in each division has been calculated from the estimated total of deaths, by assuming a uniform case fatality rate of 20 per cent—that is, multiplying the number of deaths by five and taking the nearest round number. Obviously, the numbers given both for deaths and for cases, as estimated on these principles, vary more or less widely from the true figures. It is believed, however, that in both cases the figures given are conservative, representing a probable minimum.

The deaths estimated to have occurred in nonregistration territory are calculated by applying to populations which are largely rural, death rates observed more largely in urban populations in the same divisions. As a general rule, the death rates from poliomyelitis in cities are less than in rural communities in corresponding States. It may therefore be assumed that in general the number of deaths estimated to have occurred in nonregistration territory is under rather than above the true total.

As regards cases estimated on the basis of an assumed 20 per cent case fatality, these likewise are almost certainly underestimates, for, prior to 1916, a case fatality as high as 20 per cent had been noted only exceptionally in areas where full case reports had been obtained.

Tables No. 5 to 11 are intended chiefly as base tables, showing in detail, for each State, data which may be more advantageously presented and discussed in summaries. Some study of these detailed tables is, however, worth while as showing precisely what deficiencies exist in the data used in subsequent summaries. In particular, these tables show the irregularities and deficiencies in available morbidity reports, and illustrate the futility of attempting comparisons based solely on the latter.

Turning to the broader summaries presented in Tables Nos. 13 to 19, it is somewhat surprising to note how many deaths from poliomyelitis occur each year in the United States, and how great is the total number of cases as indicated by these estimates which, as has been previously emphasized, are believed to err on the side of conservatism.

The following tables give a general summary of the prevalence of poliomyelitis from 1909 to 1915 and a summary of cases of the disease reported and estimated in each principal geographic division for the years from 1909 to 1916.

TABLE 20.—*General summary: Prevalence of poliomyelitis in United States 1909–1915—Total deaths and cases, reported and estimated.*

Year.	Registration area.			Total area.					
	Population, estimated, July 1, 1916.	Deaths from poliomyelitis.		Population, estimated, July 1, 1916.	Deaths from poliomyelitis, estimated.	Cases of poliomyelitis.			
						Reported.		Estimated.	
		Number.	Rate per 100,000.			Number.	Rate per 100,000.	Number.	Rate per 100,000.
1909	51,507,129	569	1.17	91,972,226	1,135	3,474	3.8	6,300	6.9
1910	53,837,554	1,459	2.71	92,309,348	2,449	7,320	7.9	12,300	13.3
1911	59,219,460	1,060	1.79	93,927,342	1,762	2,598	2.8	8,900	9.5
1912	60,427,237	1,136	1.88	95,545,336	1,625	3,970	4.2	8,100	8.5
1913	63,323,990	864	1.40	97,163,330	1,290	3,066	3.2	6,400	6.6
1914	65,993,445	720	1.09	98,781,334	1,027	1,862	1.9	5,000	5.1
1915	67,292,911	691	1	100,399,318	1,020	2,294	2.3	5,100	5.1
1916	....	....	....	102,017,312	....	29,061	28.5	....	....

TABLE No. 21.—*Summary of cases of poliomyelitis, reported and estimated, in each principal geographic division of the United States by years, 1909–1916.*

[No estimate for 1916; reported cases only.]

	1909		1910		1911		1912	
	Reported.	Estimated.	Reported.	Estimated.	Reported.	Estimated.	Reported.	Estimated.
New England	952	1,100	1,363	1,363	370	595	237	460
Middle Atlantic	215	1,075	1,509	2,445	709	1,525	1,419	1,835
East North Central	116	705	493	1,465	499	1,875	1,058	1,955
West North Central	2,090	2,400	2,482	3,795	290	1,280	271	1,225
South Atlantic	10	260	643	1,725	433	1,455	326	1,020
East South Central	5	260	17	250	78	1,180	65	635
West South Central	3	280	7	185	88	510	17	260
Mountain	9	130	158	235	27	135	24	180
Pacific	74	105	648	820	104	305	553	655
Total	3,474	6,300	7,320	12,300	2,598	8,900	3,970	8,100

	1913		1914		1915		1916
	Reported.	Estimated.	Reported.	Estimated.	Reported.	Estimated.	Reported (incomplete).
New England	551	650	496	680	268	465	3,373
Middle Atlantic	719	1,310	372	860	455	895	19,459
East North Central	485	1,120	337	880	698	1,075	2,670
West North Central	297	895	121	550	246	725	1,357
South Atlantic	573	1,035	212	1,000	341	995	1,013
East South Central	144	895	208	545	164	440	640
West South Central	145	170	16	85	32	255	212
Mountain	36	140	23	145	17	85	137
Pacific	116	235	77	245	73	165	200
Total	3,066	6,400	1,862	5,000	2,294	5,100	29,061

Considering the United States as a whole, the seven years, 1909 to 1915, inclusive, appear to mark a cycle in the prevalence of poliomyelitis. The disease which, in 1907, appeared in New York City as an epidemic previously unprecedented, presumably increased during

1908, for which year no statistics are available, and 1909, reaching a culmination in 1910. Since that year there has been a rather steady decrease in mortality and morbidity until 1916. It will be noted that the decrease since 1910, both in cases and deaths, is entirely regular and unbroken according to the figures derived by estimates, whereas according to actual mortality and morbidity reports the downward tendency was interrupted during 1912. The discrepancy in ratio of reported to estimated deaths and cases from year to year is attributed to the fact that in different years different proportions of the reported deaths have occurred in States lying wholly within the registration area.

Considered in connection with this cycle of progressive decrease since 1910, the epidemic of 1916 would appear to mark the beginning of another cycle, whether it be a culmination, corresponding to that of the year 1910 or the beginning of an upward tendency as in 1907.

While it may be a mere coincidence, it is worthy of note in this connection that in Sweden the two great epidemics of recent years, occurring in 1905 and 1911, respectively, were separated by the same interval of years as the epidemics of 1910 and 1916 in the United States. It must, however, remain for the future to determine whether or not a six-year cycle is generally characteristic of poliomyelitis.

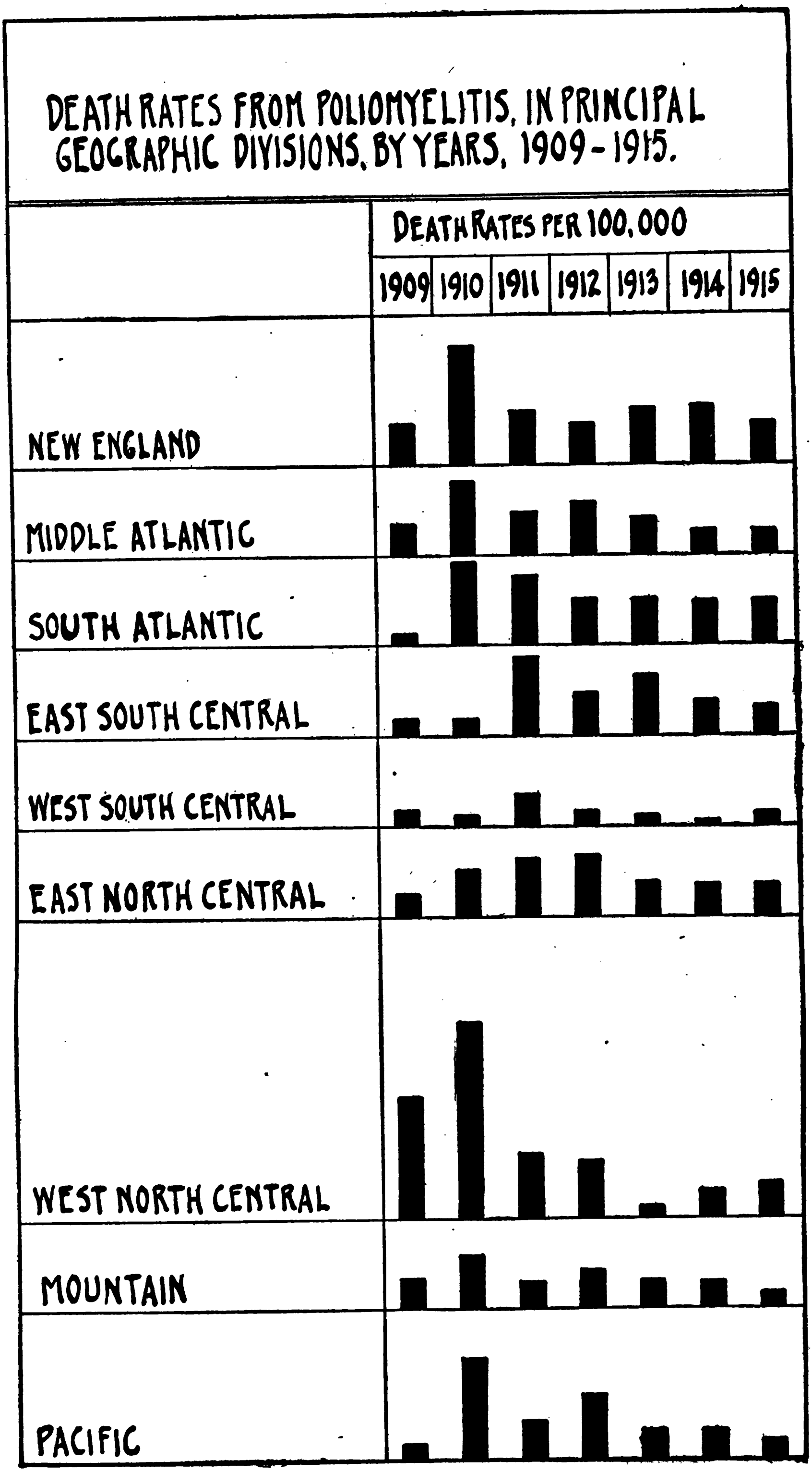
The following table gives the death rates from 1909 to 1915 in the principal divisions of the United States:

TABLE 22.—*Death rates from poliomyelitis in principal geographic divisions, by years, 1909–1915.*

[Death rate per 100,000 per annum.]

Divisions.	1909	1910	1911	1912	1913	1914	1915
New England	1.39	4.03	1.78	1.36	1.89	1.97	1.38
Middle Atlantic	1.11	2.52	1.54	1.82	1.27	.82	.84
South Atlantic	.42	2.82	2.35	1.62	1.63	1.54	1.52
East South Central	.62	.60	2.66	1.47	2.06	1.24	1.00
West South Central	.63	.42	1.13	.56	.36	.17	.51
East North Central	.78	1.59	1.96	2.08	1.18	1.07	1.11
West North Central	4.14	6.51	2.17	1.89	.36	.90	1.17
Mountain	1.01	1.80	.87	1.27	.94	.97	.55
Pacific	.51	3.43	1.27	2.19	.99	.99	.65

A study of this table shows that in the various sections of the country the cycle has not been synchronous but rather progressive, resembling a wave passing outward from two centers, one in the Northeastern States and the other in the West North Central States. Referring to chart No. 3, it will be noted that the New England and Middle Atlantic States showed relatively high mortality rates in 1909, reaching a maximum in 1910, since which time there has been a rather steady decline, with minor secondary rises. The South Atlantic States, adjoining the Middle Atlantic, showed a low mor-



DEATH RATES FROM POLIOMYELITIS, IN PRINCIPAL GEOGRAPHIC DIVISIONS, BY YEARS, 1909-1915.

CHART NO. 3.

tality rate in 1909, a maximum in 1910, with a relatively small decline in 1911, while the East South Central and West South Central States show a distinctly later rise in mortality rates, reaching a maximum in 1911 and 1913. It would appear, then, that a wave of increased prevalence, or at least increased mortality, had progressed from the Northeastern States south and west, reaching its crest distinctly later in the South Atlantic and East South Central States than in the New England and Middle Atlantic divisions.

However, the most distinct epidemic focus in 1909 was not in the Northeastern States, but in the West North Central division, especially in Minnesota. The wave of high prevalence in these States, beginning in 1909, or possibly in 1908, and reaching its maximum in 1910, appears distinctly later in the divisions east, west, and south.

While the general tendency in each of the groups of States represented has been toward a rise in mortality rate, reaching a maximum in 1910 or 1911, followed by a fairly uniform decrease to a minimum in 1913, 1914, or 1915, it will be noted that in each division, with few exceptions, there has been a secondary rise in mortality rate, two or more years subsequent to the first year.

A closer study of this tendency to cyclic recurrence of relatively high mortality rates may be made from the data in Table No. 12, showing the annual mortality rates in the registration portion of each individual State. This is still better shown in chart No. 4, prepared to illustrate this table. This chart also shows in more detail for individual States the same tendency toward progressive spread of high mortality rates, apparently spreading outward from the two foci previously mentioned. In order to better illustrate this tendency the States may have been arranged in order in three groups, viz:

First. A group in order from the northern New England States south and west to Florida.

Second. A group arranged in order of contiguity from Minnesota, respectively, southeast to Louisiana and southwest to Texas.

Third. Again in order from Minnesota, southwest through Nebraska and Colorado to Utah, and west through Montana, Washington, and Oregon to California.

The same phenomena of alternate rise and fall in mortality rates in each State and of apparent progression from certain centers are again illustrated in the accompanying maps, Nos. 1 to 7.

Bearing in mind the deficiencies in available data and the small number of deaths from which mortality rates have necessarily been computed in certain States and divisions, it is not justifiable to attach a too definite significance to these phenomena. However, they are too regular to be attributable merely to chance. Moreover, both the progressive, regular spread, and the alternate high and low prevalence indicated by these figures are entirely consistent with what has been observed on a smaller scale in areas intensively studied. Reference is made in this connection to the discussions in subsequent sections of this report relative to the passage of the 1916 epidemic from section to section of New York City, and its radial spread from New York City through the northeastern United States.

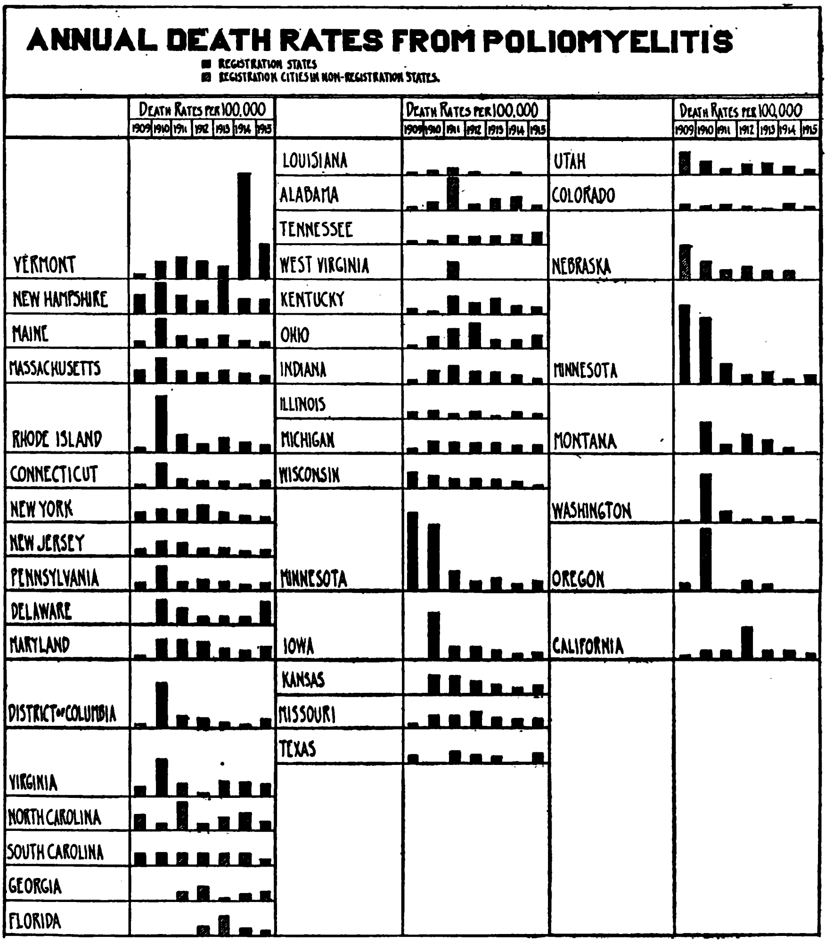
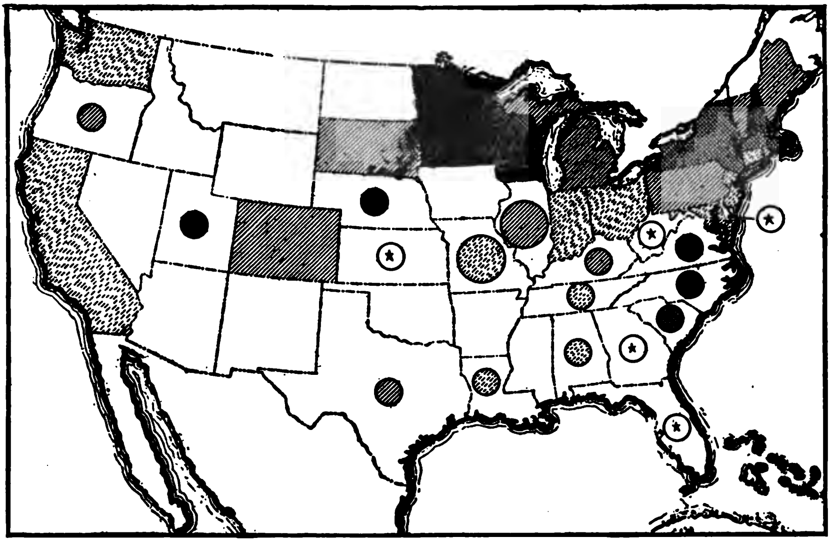


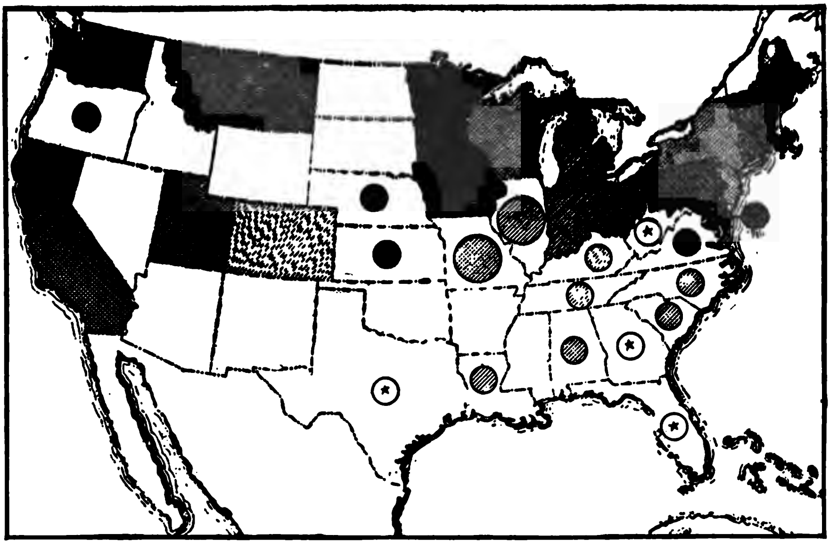
CHART No. 4.

As to the significance of these facts, in so far as they justify any conclusion, they appear to furnish additional support to the general idea developed in subsequent sections of this report that poliomyelitis is probably a widespread endemic infection most similar perhaps to measles in its wide prevalence and its tendency to periodic epidemic occurrence.

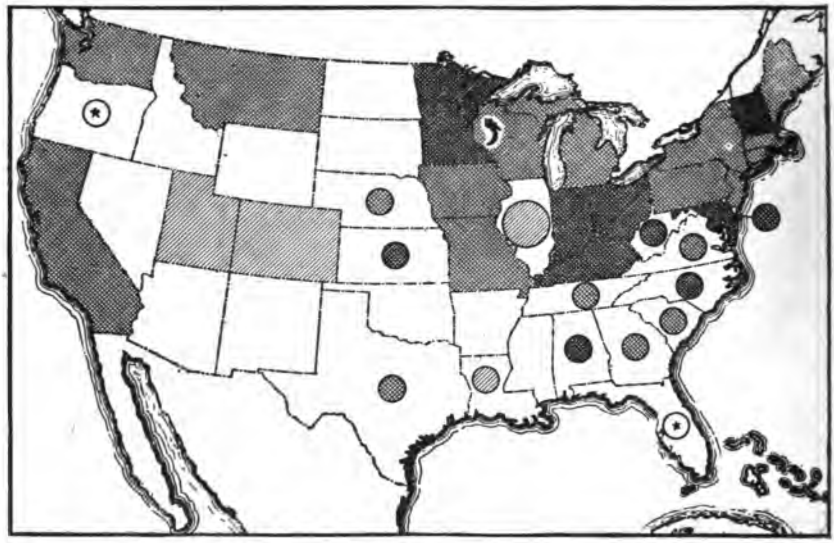
MAPS 1-7.—PREVALENCE OF POLIOMYELITIS IN THE UNITED STATES, BY YEARS, 1909 TO 1915, AS SHOWN BY THE MORTALITY STATISTICS OF THE UNITED STATES CENSUS BUREAU.



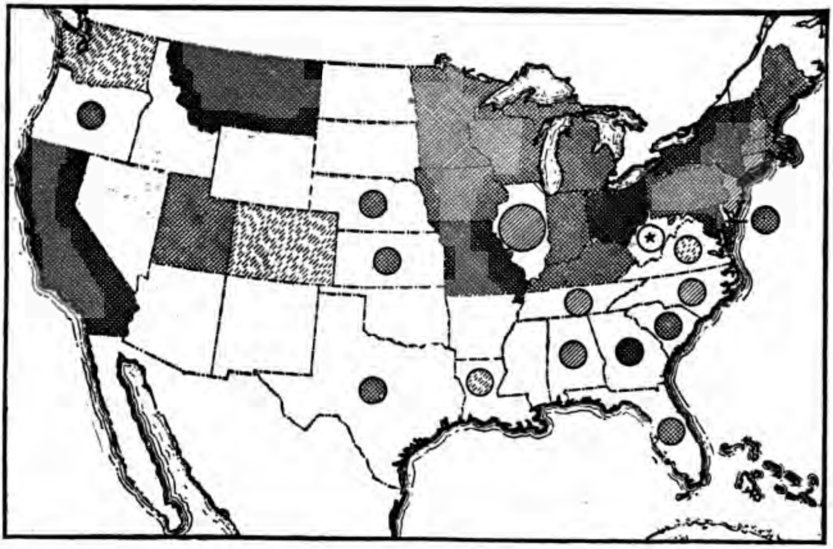
MAP 1909.
(For legend, see p. 74.)



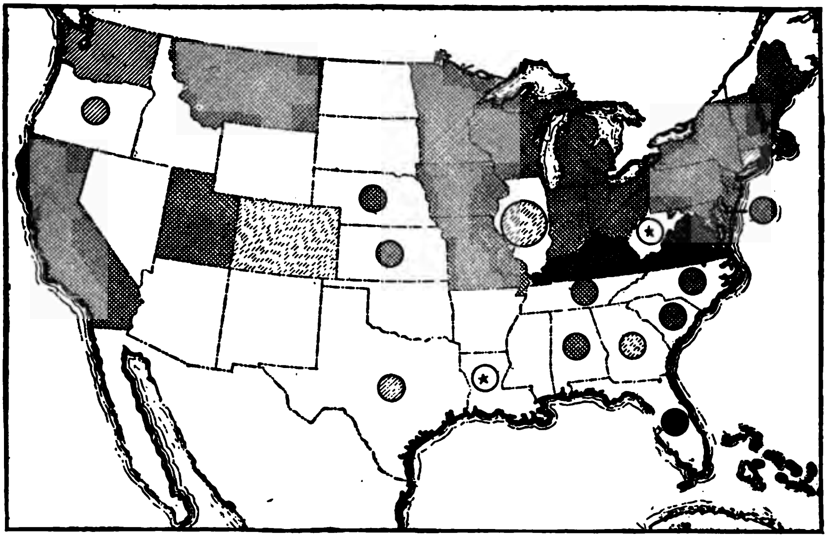
MAP 1910.



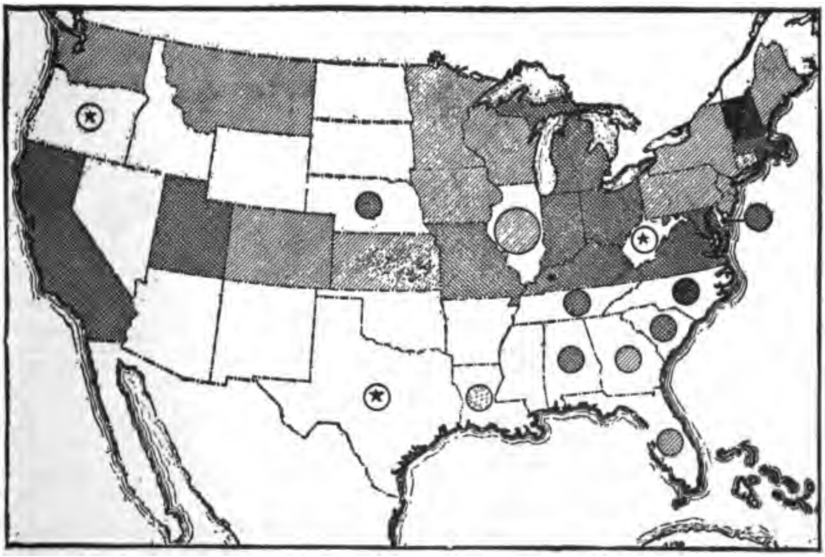
MAP 1911.



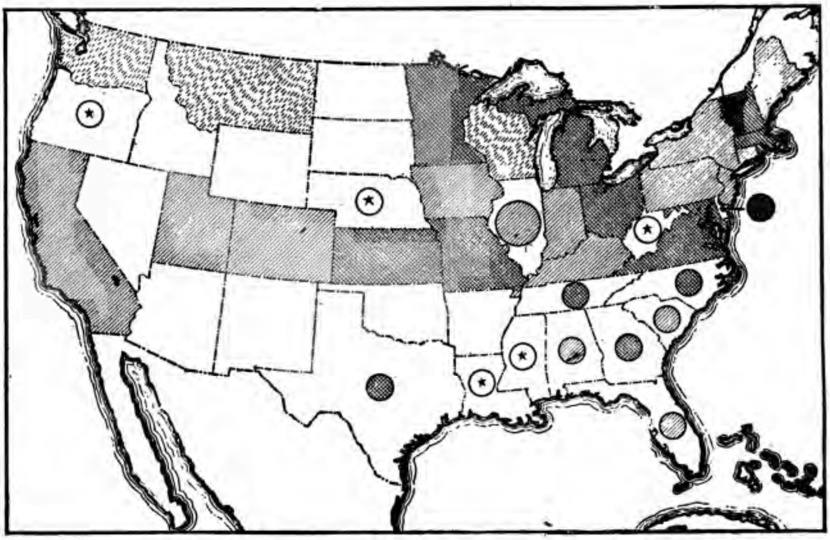
MAP 1912.



MAP 1913.



MAP 1914.



Map 1915.

In these maps death rates per 100,000 have been indicated as follows:

★	0
▨	0.0–0.5
▨	0.5–1.0
▩	1.0–2.0
▩	2.0–5.0
■	Over 5.0
○	Registration, city only.

Areas left blank indicate "no data."

In order to bring out what may at first thought appear a far-fetched analogy between measles and poliomyelitis, Table No. 23 has been prepared, showing for the registration portion of each State the death rates from measles for the years 1910–1914, as given in the mortality statistics of the United States Census Bureau for these years.

TABLE No. 23.—*Death rates from measles, by States, 1910–1914.*

[Death rates per 100,000 from measles in registration area of each State.]

States.	1910	1911	1912	1913	1914
Maine	13.0	4.1	7.7	8.2	5.6
New Hampshire	6.7	9.2	4.4	12.4	8.4
Vermont	6.7	10.6	7.2	20.3	1.1
Massachusetts	11.6	8.9	11.3	14.1	5.5
Rhode Island	32.6	4.1	20.0	12.2	9.6
Connecticut	8.2	8.2	10.1	8.5	12.0
New York	13.9	10.6	10.8	11.5	8.6
New Jersey	9.9	10.7	11.0	7.8	8.1
Pennsylvania	16.1	10.3	10.6	19.5	6.7
Ohio	16.5	6.4	8.2	13.7	4.8
Indiana	16.6	9.6	2.5	16.1	5.4
Illinois	[1] 8.5	[1] 6.0	[1] 5.1	[1] 12.2	[1] 2.9
Michigan	9.0	6.9	3.9	8.6	5.9
Wisconsin	8.0	10.7	5.2	7.6	6.0
Minnesota	11.9	5.3	1.0	9.5	3.6
Iowa	(2)	(2)	(2)	(2)	(2)
Missouri	[1] 15.9	18.7	1.7	13.1	12.2
North Dakota	(2)	(2)	(2)	(2)	(2)
South Dakota	(2)	(2)	(2)	(2)	(2)
Nebraska	[1] 5.8	[1] 9.9	[1] 4.0	[1] 5.7	[1] 1.1
Kansas	[1] 21.2	[1] 5.5	[1] 5.2	[1] 9.2	[1] 1.8
Delaware	[1] 1.1	[1] 13.5	[1] 2.2	[1] 15.4	[1] 16.2
Maryland	4.1	9.9	2.7	15.1	1.8
District of Columbia	1.2	6.5	2.0	7.8	0.8
Virginia	[1] 10.6	[1] 7.1	[1] 2.6	17.1	5.4
West Virginia	[1] 7.2	[1] 16.7	[1] .0	[1] 4.7	[1] 9.8
North Carolina	[1] 27.1	[1] 15.5	[1] 10.9	[1] 27.0	[1] 10.8
South Carolina	[1] 22.1	[1] .0	[1] .0	[1] 13.4	[1] 6.7
Georgia	[1] 6.8	[1] 20.8	[1] 7.8	[1] 4.1	[1] 10.8
Florida	[1] 8.8	[1] 20.4	[1] 2.4	[1] 8.5	[1] 1.7
Kentucky	[1] 8.6	19.7	2.8	17.0	11.5
Tennessee	[1] 7.2	[1] 37.0	[1] 2.1	[1] 16.1	[1] 10.8
Alabama	[1] 10.7	[1] 24.2	[1] 7.4	[1] 4.7	[1] 18.7
Mississippi	(2)	(2)	(2)	(2)	(2)
Arkansas	(2)	(2)	(2)	(2)	(2)
Louisiana	[1] 19.4	[1] 11.8	10.6	[1] 9.8	[1] 2.2
Oklahoma	(2)	(2)	(2)	(2)	(2)
Texas	[1] 3.0	[1] 16.0	[1] 7.4	[1] 34.0	[1] 9.8
Montana	4.2	12.5	1.5	12.9	6.2
Idaho	(2)	(2)	(2)	(2)	(2)
Wyoming	(2)	(2)	(2)	(2)	(2)
Colorado	8.0	15.0	1.9	4.0	9.8
New Mexico	(2)	(2)	(2)	(2)	(2)
Arizona	(2)	(2)	(2)	(2)	(2)
Utah	1.3	10.9	3.8	31.6	2.9
Nevada	(2)	(2)	(2)	(2)	(2)
Washington	6.6	5.6	1.2	8.0	3.6
Oregon	[1] 3.8	[1] 8.6	[1] 0.4	[1] 2.4	[1] 8.1
California	7.4	3.2	5.5	5.8	6.1

[1] Nonregistration State. Data refer to registration cities in the State.
[2] Nonregistration State. No data.

The similarity between measles and poliomyelitis, both in the alternate rise and fall of mortality rates in individual States and in the apparent progression of high prevalence from State to State, is shown by comparing chart No. 4 with the similar chart (No. 5) showing death rates from measles.

It is unfortunate that a study of such important phenomena should have to be based upon such unsatisfactory data. Mortality statistics, even if complete and uniform in all States, can never furnish an entirely satisfactory basis for such a study, which requires for its full development uniform and complete morbidity reports—the foundation of all effective public-health work.

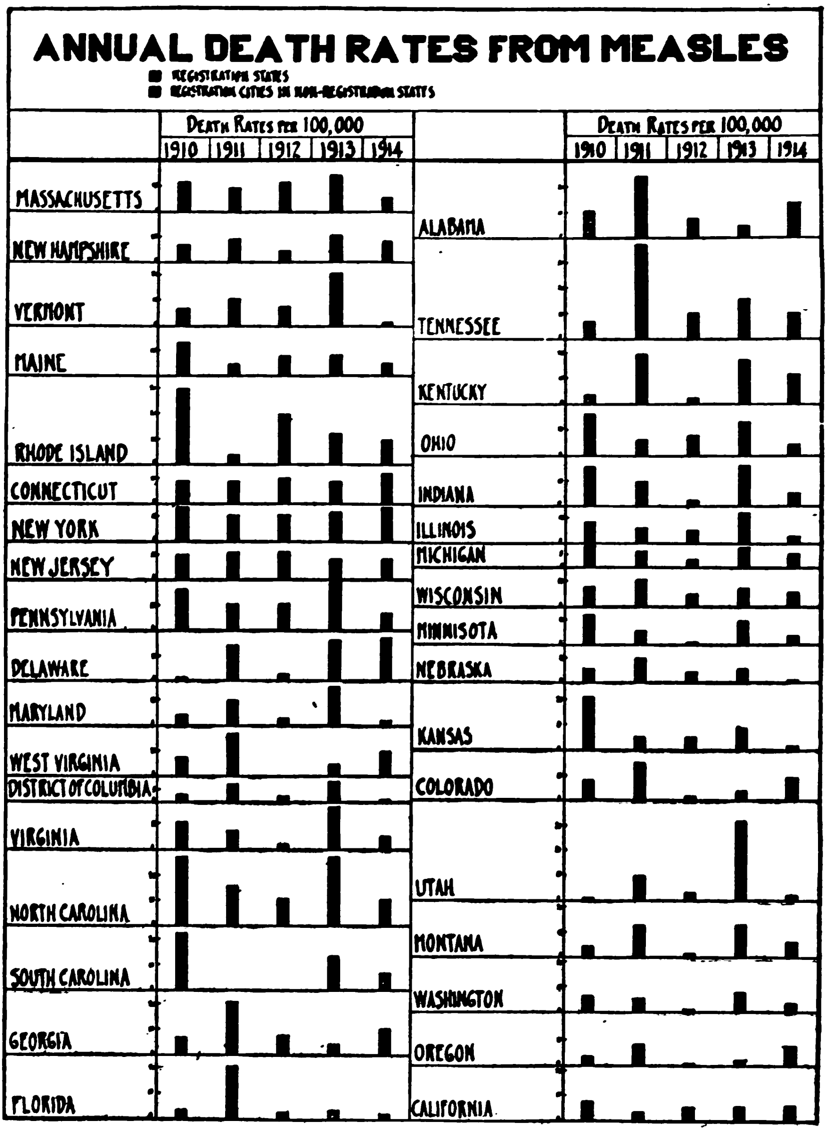


CHART No. 5.

To the tables already given in this section there are added three more which are thought to be of interest in this connection. Table No. 24 gives the reported cases and deaths for the United States, by States and divisions, for 1916, with rates. Table No. 25 likewise gives the prevalence and rates for the United States, 1916, by States, for the months of epidemic prevalence only.

TABLE No. 24.—*Poliomyelitis in United States, 1916, reported deaths and cases, by States and divisions.*

[From reports made to the Surgeon General and published in Public Health Reports.]

States.	Estimated populations, July 1, 1916.	Cases reported.		Deaths registered.	
		Number.	Indicated rate per 1,000 population.	Number.	Indicated fatality rate per 100 cases.
Maine	772,489	149	0.193	....	....
New Hampshire	442,506	61	.137	....	....
Vermont	363,699	64	.176	12	18.75
Massachusetts	3,719,156	1,926	.518	424	22.01
Rhode Island	614,315	222	.362	....	....
Connecticut	1,244,479	951	.764	235	24.71
Total	7,156,644	3,373	.471	671	....
New York	10,273,375	13,223	1.287	3,331	25.19
New Jersey	2,948,017	4,055	1.376	1,180	29.10
Pennsylvania	8,522,017	2,181	.256	....	....
Total	21,743,409	19,459	.894	4,511	....
Ohio	5,150,356	546	.106	....	....
Indiana	2,816,817	207	.073	50	24.15
Illinois	6,152,257	826	.102	....	....
Michigan	3,054,854	616	.202	138	22.40
Wisconsin	2,500,350	475	.190	79	16.63
Total	19,674,634	2,670	.131	267	....
Minnesota	2,279,603	909	.399	105	11.55
Iowa	2,220,321	259	.117	51	19.69
Missouri	3,410,692	11	.003	....	....
North Dakota	739,201	23	.031	....	....
South Dakota	698,509	38	.054	....	....
Nebraska	1,271,375	14	.013	....	....
Kansas	1,829,545	103	.056	26	25.24
Total	12,449,246	1,357	.109	182	....
Delaware	213,380	79	.374	....	....
Maryland	1,362,807	352	.258	111	31.53
District of Columbia	363,980	39	.107	6	15.38
Virginia	2,192,019	330	.151	59	17.88
West Virginia	1,386,038	82	.059	....	....
North Carolina	2,402,738	....	....	....	....
South Carolina	1,625,475	123	.076	36	29.27
Georgia	2,856,085	....	....	....	....
Florida	893,493	8	.009	....	....
Total	13,295,995	1,013	.076	212	....
Kentucky	2,379,639	146	.061	48	32.88
Tennessee	2,288,004	39	.017	....	....
Alabama	2,332,608	186	.080	51	27.42
Mississippi	1,951,674	269	.138	31	11.52
Total	8,951,925	640	.071	130	....
Arkansas	1,739,723	14	.008	....	....
Louisiana	1,829,130	77	.042	18	23.38
Oklahoma	2,202,081	35	.016	....	....
Texas	4,429,566	86	.019	35	40.70
Total	10,200,500	212	.021	53	....
Montana	459,494	94	.205	26	27.66
Idaho	428,586	9	.021	....	....
Wyoming	179,559	7	.039	3	42.86
Colorado	962,060	16	.017	....	....
New Mexico	410,283	....	....	....	....

TABLE No. 24.—*Poliomyelitis in United States, 1916, reported deaths and cases, by States and divisions*—Continued.

States.	Estimated populations, July 1, 1916.	Cases reported.		Deaths registered.	
		Number.	Indicated rate per 1,000 population.	Number.	Indicated fatality rate per 100 cases.
Arizona	255,544	6	0.023	....	....
Utah	434,083	5	.012	....	....
Nevada	106,734	....	....	....	....
Total	3,236,343	137	.042	29	....
Washington	1,534,221	30	.020	7	23.33
Oregon	835,741	38	.045	4	10.53
California	2,938,654	132	.045	26	19.70
Total	5,308,616	200	.038	37	18.50
Grand total	102,017,312	29,061	.285	6,092	....

TABLE 25.—*Poliomyelitis in United States, 1916—Reported cases, by States, by months, with rates per 100,000 population.* (*See Map No. 8.*)

[For the months of epidemic prevalence.]

[Compiled from Public Health Reports, supplemented by personal reports from State health officers.]

States.	July.	August.	September.	October.	Total.	Rate.
New Jersey	640	2,114	957	254	3,965	134.4
New York (exclusive of New York City)	517	1,527	1,064	334	3,442	78.2
Connecticut	165	367	274	91	897	72.1
Massachusetts	107	252	623	702	1,684	45.27
Minnesota	142	377	199	148	866	37.9
Rhode Island	26	57	70	67	220	35.8
Delaware [1]	1	11	36	28	76	35.7
Maine [2]	0	26	46	46	118	23.3
Maryland [3]	10	64	100	120	294	21.6
Pennsylvania	107	711	743	250	1,811	21.2
Montana [4]	11	28	33	15	[5] 87	18.95
Wisconsin [5]	20	173	158	84	435	17.4
Michigan	51	163	166	97	477	15.61
Vermont	1	8	23	19	51	14.0
Illinois	76	339	257	154	826	13.45
New Hampshire [1]	7	16	33	5	61	13.8
Iowa	30	82	66	31	209	9.42
District of Columbia	8	18	6	4	36	9.9
Ohio	94	168	138	56	456	8.86
South Carolina	20	58	24	13	115	7.08
Virginia	24	44	64	22	154	7.02
Alabama [6]	77	62	12	8	159	6.82
Indiana [7]	27	38	67	57	189	6.72
Mississippi	57	31	14	10	112	5.74
South Dakota	5	19	14	0	38	5.44
Kansas	14	31	19	22	86	4.7
Oregon	0	0	5	28	33	3.95
West Virginia	5	10	18	18	51	3.68
North Dakota	0	2	16	5	23	3.11
Arizona	2	2	2	0	6	2.35
Wyoming	0	1	3	0	4	2.22
California	12	18	13	21	64	2.18
Idaho	0	4	3	2	9	2.1
Oklahoma [8]	12	10	13	0	35	1.59
Kentucky [9]	15	19	1	0	35	1.47
Texas	22	25	16	0	63	1.42
Washington	5	2	10	4	21	1.37
Colorado	1	2	4	5	12	1.25
Utah	0	5	0	0	5	1.15
Louisiana	19	6	5	3	33	1.8
Tennessee	18	21	0	0	39	1.7
Nebraska	1	7	6	0	14	1.1
Florida [7]	4	3	1	....	8	.89
Arkansas	5	1	5	....	11	.63
Missouri	4	3	4	....	11	.32
Nevada	0	0	0	....	....	....
New Mexico	0	0	0	....	....	....
Georgia [10]	....	....	....	....	....	....
North Carolina [10]	....	....	....	....	....	....

---

[1] Oct. 1 to Dec. 2.

[2] Oct. 1 to Nov. 25; 19 cases Oct. 1 to 21.

[3] Oct. 1 to Nov. 18; 37 cases Oct. 1 to 21.

[4] Oct. 8 to 31.

[5] Not including cases on Crow Reservation.

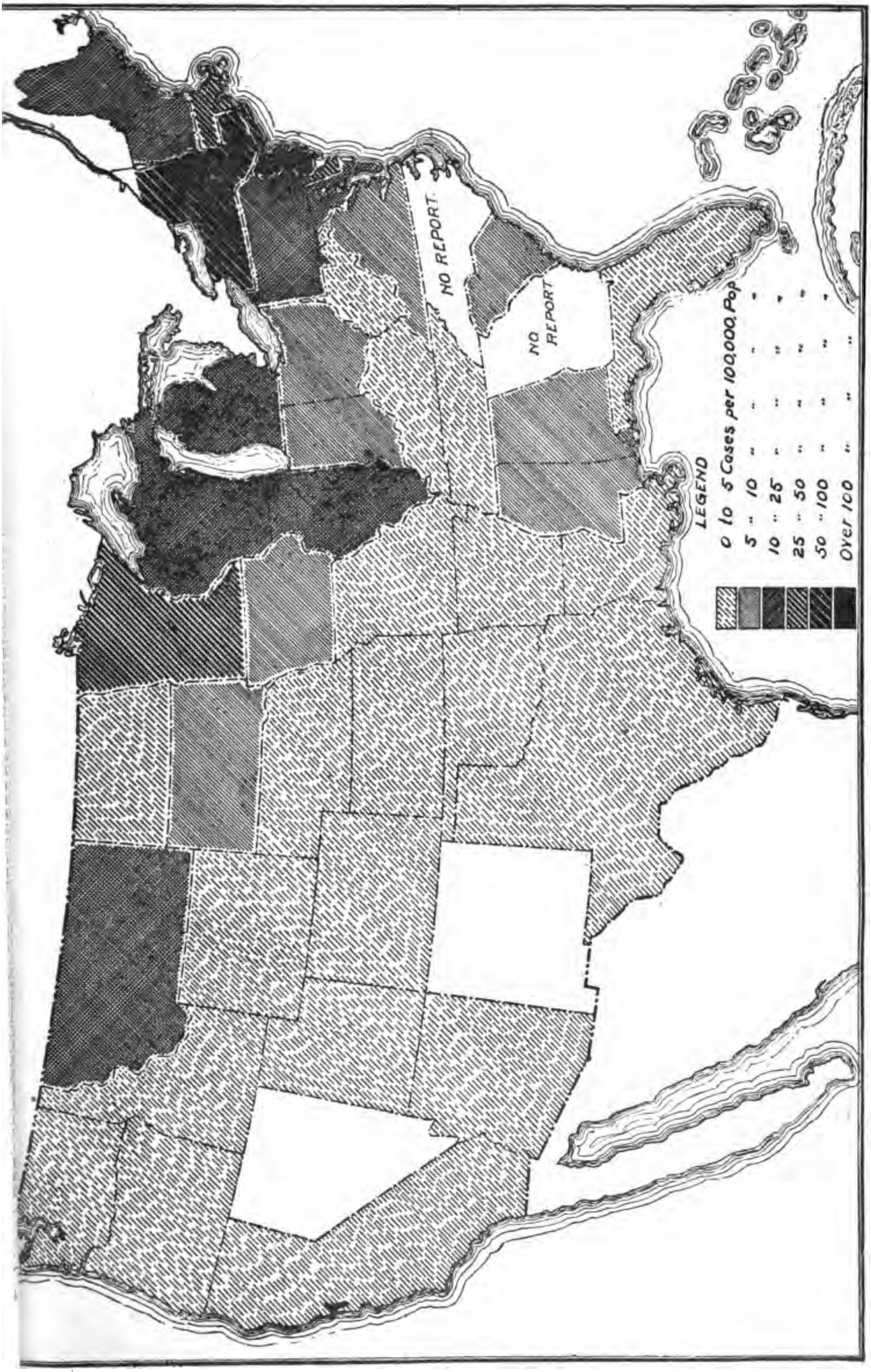
[6] Oct. 1 to 21.

[7] Sept. 1 to 25.

[8] Sept. 1 to Nov. 15.

[9] To Sept. 28.

[10] Disease present. No report.



MAP No. 8.—Poliomyelitis in the United States, 1916. Geographic distribution of cases during the months of epidemic prevalence (see Table No. 25).

The data in these two tables are incomplete, but more complete data are not yet available. The two tables were compiled from reports made to the Surgeon General of the Public Health Service, as published in the Public Health Reports, supplemented by information collected from other sources. In spite of some discrepancies and the incomplete information available these two tables are believed to give a fairly accurate idea of the prevalence of poliomyelitis in the United States during 1916.

Table No. 26 gives interesting information compiled from the publications of the United States Census Bureau.

TABLE NO. 26.—*All deaths from poliomyelitis in registration area, 1910 to 1915, inclusive, urban and rural distribution and age distribution by States.*

[Compiled from United States Mortality Statistics, 1910 to 1915.]

	Deaths.		Age distribution.					
	City.	Rural.	Total.	Under 1.	1 to 4.	5 to 9.	10 to 19.	Over 19.
California	152	112	264	32	116	52	33	31
Colorado	8	21	29	4	11	6	3	5
Connecticut	58	33	91	14	37	15	13	12
Indiana	62	199	261	51	118	42	29	21
Kansas	7	26	33	9	12	6	3	3
Kentucky	31	169	200	65	99	22	6	8
Maine	23	58	81	12	21	14	14	19
Maryland	54	101	155	34	80	16	9	16
Massachusetts	291	94	385	58	162	47	50	68
Michigan	83	163	246	39	99	37	32	39
Minnesota	64	301	365	57	110	71	78	49
Missouri	47	215	262	63	137	32	14	16
Montana	9	37	46	9	23	4	8	2
New Hampshire	38	39	77	12	28	4	19	14
New Jersey	115	81	196	42	86	30	20	18
New York	581	273	854	136	392	117	92	117
North Carolina	19	27	46	12	20	6	4	4
Ohio	287	317	604	117	308	87	46	46
Pennsylvania	257	467	724	131	333	109	66	85
Rhode Island	74	20	94	14	45	15	12	8
Utah	16	15	31	8	14	4	3	3
Vermont	12	95	107	9	26	19	25	28
Virginia	14	109	123	39	47	17	8	12
Washington	64	72	136	20	52	30	26	16
Wisconsin	54	115	169	39	54	38	17	21
District of Columbia	37	....	37	62	160	47	29	44
Other registration cities	314	....	314	....	....	....	....	....
Total	2,771	3,159	5,930	1,080	2,590	887	659	714

II. THE EPIDEMIC OF POLIOMYELITIS IN NEW YORK CITY, 1916.

This section is devoted to the epidemic as it occurred in Greater New York. As will appear, the section is divided into two general parts: First, a general statistical and epidemiologic study covering the entire city; and, second, an intensive study of all the cases in one borough. These studies, as noted, were made in cooperation with the department of health of New York City, the data for the general study having been taken from the records of the department. The data for the intensive study were collected by the Public Health Service. As already explained, the purpose of the two studies was to permit both a general and a detailed view of the New York City epidemic. The character of the two studies and their relations to each other will become apparent to the reader as the discussion proceeds.

Perhaps it is best to say at the outset that no attempt has been made to correlate the final tabulations presented in this report with those of the department of health. Copies were made of all of the department's case cards, as described later, and the figures of this report were compiled from these original records independently. Under such circumstances discrepancies will naturally occur, but it is not thought that any of these discrepancies could be of sufficient importance materially to modify the results obtained.

BRIEF DESCRIPTION OF THE CITY.[1]

New York is the second largest city of the world, having a population of 5,602,841, as estimated by the United States Bureau of the Census, for July 1, 1916. It is situated at the confluence of the Hudson River with Long Island Sound and New York Bay. In its topography it is remarkable chiefly for its extensive water front. Practically every section of the city is almost entirely surrounded by salt water.

While the entire city is under one general municipal government, it is divided for administrative purposes into five divisions called boroughs. These boroughs have populations, areas, and population densities as shown in the following table:

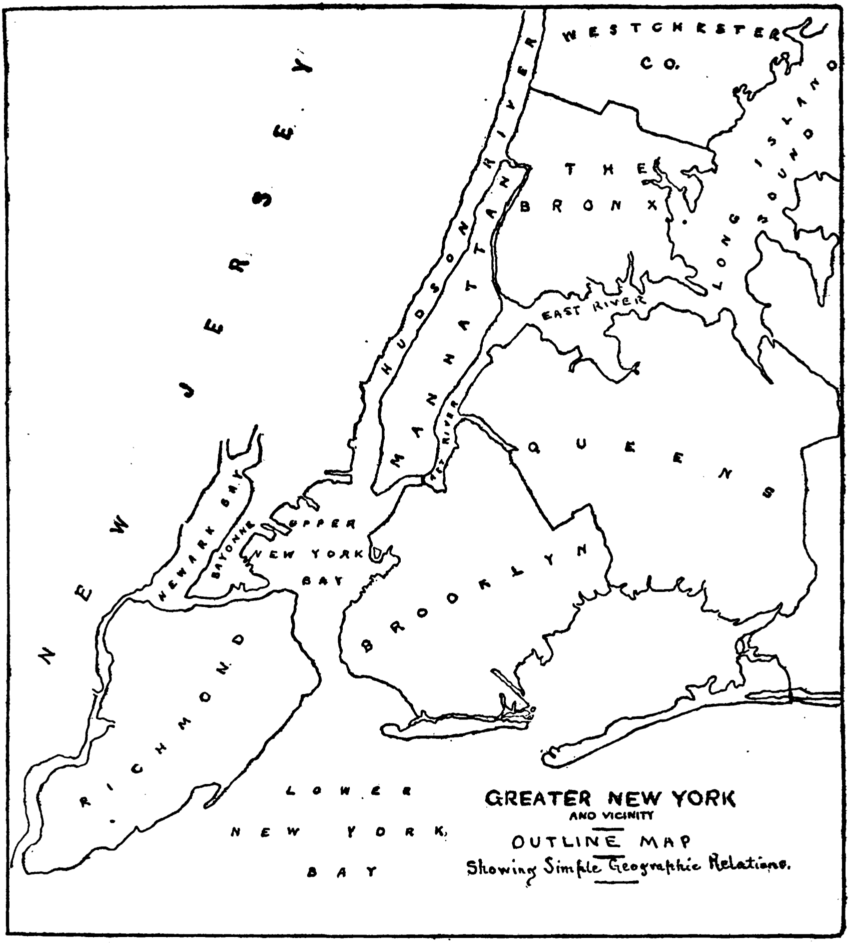
---

[1] See map 9.

TABLE 27.—*Population and areas of boroughs in New York.*

Borough.	Population (estimated 1916).	Area in acres.	Density of population per acre.
Manhattan	2,634,224	14,038	187.7
Bronx	575,876	26,017	22.1
Brooklyn	1,928,734	49,680	38.8
Queens	366,126	82,883	4.4
Richmond	97,881	36,600	2.7
The city	5,602,841	209,218	26.8

Manhattan Borough, which, with the Bronx, constituted the city of New York prior to the organization of Greater New York in 1896, occupies the whole of the original Manhattan Island. It is a narrow strip, lying between the Hudson and East Rivers, and separated on the north from the mainland by the Harlem River. The entire area of the borough is thickly built up, the average density of population



MAP No. 9.

being 187 persons per acre. In some wards the density is as high as 700 per acre, and in some blocks as high as 1,100 per acre. The southern end of the island is given up almost entirely to business, the business area extending up the center of the island, dividing the tenement-house area into two strips, known locally as the East Side and West Side. While both the East and West Sides are thickly built up with flats and tenements for practically the whole length of the island, the lower East Side is very thickly populated, being probably the most thickly populated area in the entire world. The upper part of the island is almost entirely residential. On the upper West Side are found the apartment houses of the better and more modern class.

The Borough of the Bronx lies just across Harlem River from Manhattan, and is practically an extension northward of Manhattan. The portions of the borough nearest to Manhattan are thickly built up with tenements and apartments, but farther north the residences become scattered, with large areas of vacant land. Along the extreme northern edge of the borough conditions are typically suburban. The Bronx is connected with Manhattan by numerous bridges and tunnels, and a large part of the population goes daily to business in lower Manhattan.

Brooklyn, lying across East River from Manhattan, was originally a separate municipality. It occupies the extreme western end of Long Island. While the population is very dense in the central and western portions of the borough, it nowhere approaches the crowded conditions of Manhattan, and there are large areas of suburban homes. Brooklyn likewise has numerous detached residences and small flat houses, with very few of the towering tenements so characteristic of Manhattan.

Along the extreme southern border of Brooklyn, facing the Atlantic Ocean, are several seaside resorts, largely patronized at certain seasons of the year. The largest of these, Coney Island, is visited by hundreds of thousands of persons on favorable days during the summer months.

The Borough of Queens adjoins Brooklyn on the east, and in its western parts is practically continuous with the latter borough. Farther east, however, the territory is thinly settled, and is largely suburban, with numerous small villages.

The Borough of Richmond lies across the bay to the south, and occupies the whole of Staten Island. It is the most thinly settled of all the boroughs. It communicates with both Manhattan and Brooklyn by frequent ferry service. Many of its inhabitants work in other boroughs, using the ferries morning and evening. This borough possesses also ferry connections with the State of New Jersey.

The population of the Borough of Richmond is largely concentrated in a series of small towns located along the northern and eastern shores of the island. Inland the territory is sparsely settled, and conditions approach those of rural life.

From the sanitary standpoint, Brooklyn and Queens constitute one unit, and Manhattan and the Bronx another. The Borough of Richmond is definitely separated, both geographically and in the general character of life.

All of the boroughs, by frequent ferry and subway service, are not only closely connected with each other, but also with the numerous towns and cities on the New Jersey side of the Hudson River. Indeed, were it not for State lines many of the settlements in New Jersey would doubtless constitute politically, as they do actually, a part of Greater New York City.

A. GENERAL STATISTICAL AND EPIDEMIOLOGIC STUDY OF THE EPIDEMIC IN NEW YORK CITY.

This study, made in cooperation with the department of health of New York City, is based on material collected by the officers and employees of that department. All records of cases and deaths, and all reports of the investigation of cases by the inspectors and diagnosticians of the department were courteously made available for the study.

Reports of cases were received daily, and were made the basis of the department's current tabulations and reports. Each case, as soon as reported, was visited by a diagnostician and an inspector of the department. Epidemiologic information was collected on a card, previously in use in the department, a copy of which is given below:

NAME-- Date------ Borough------ Year----

Age------Sex------Marital state------------Color-----------Nationality------------

(married, single, widowed) (white, black) (of mother, if minor)

Occupation------------

ADDRESS: Street--------Number--------Floor--------Room No.--------Care of-------

Reported by -----------------Address-----------------Date-----------------

THE HOUSE:------------General condition------------Number of families-----------

Stable near? (yes) (no)---------Exposed garbage, etc., noted? (yes) (no)---------

THE HOME: General condition (good) (bad)-------------Flies (yes) (no)-------------

Vermin (yes) (no)-------------

THE FAMILY: Adults-----Children-------------------------On premises since------

0–5 yrs. 6–10 yrs. 11–20 yrs.

EXPOSURE TO INFECTION: Any contact, direct or indirect, with other case? (yes) (no) --------------------------

Details, dates of contact---

Inspector's diagnosis--------------------------------Onset: Date---------------

Paralysis: When first appeared------------Parts affected--------------------------

General symptoms: Respiratory------------------Gastro intestinal------------------

Type: 1 Abortive---------2 Spinal-----------3 Meningeal---------4 Cerebral--------

Lumbar puncture: Date------------Result------------

Precautions observed: Isolated (yes) (no)----------Death-----------From-----------

Food handlers in family (yes) (no) report----------Children attend school at----------

Excluded------------

Removal and renovation ordered----------Assigned to-----------Returned-----------

REMARKS: --
Field office record: Received---------------------Action taken--------------------
Removed to--------------------------Hospital: Date-----------Time-----------
Forwarded card------------------------
Central office record: Serial number--------Tabulated--------Forwarded card--------
Special assignment: ---
REMARKS: --

These epidemiologic cards were turned in at the office of the borough in which the case occurred, and then transmitted to the division of epidemiology of the bureau of contagious diseases of the department, where they were reviewed. Cards found to be incomplete or defective were returned to the borough office for correction. Completed cards were filed in the division of epidemiology, and were there tabulated and studied.

During the early days of the epidemic, before the work became definitely standardized, some cards were lost or mislaid, and many delays occurred in transmitting the cards to the central office. As soon as the work became systematized the cards were received with regularity and promptness. The usual time elapsing between the report of a case and the receipt of the epidemiologic card was between four days and one week.

The information called for by the epidemiologic card is probably as complete as could be reasonably expected from so large a number of cases. It includes such fundamental information regarding the cases as color, sex, age, nativity, occupation, place and time of onset, together with certain information regarding the clinical features of the disease and the environment in which the case occurred.

Since the majority of the cases were seen by the diagnostician early in the course of the disease, before the development of complete symptoms, and since most of the cases were immediately removed to a hospital, it seemed useless to attempt a study of the clinical data presented in the cards.

The character and habits of life of that part of the population in which the majority of the cases occurred, the large proportion of cases in persons of foreign birth, the conditions of overcrowding, and other difficulties, made it impossible to collect accurate information regarding exposure to known cases of the disease. For these reasons the statistical study of the epidemic was of necessity confined to the elementary epidemiologic factors of chronology, geographic distribution, sex, age, fatality, and exposure in the family.

POLIOMYELITIS IN NEW YORK CITY PRIOR TO 1916.

A severe epidemic of poliomyelitis occurred in New York City in 1907. In fact, this epidemic was the largest ever recorded for the disease up to that time. The exact number of cases is unknown, since this epidemic occurred prior to the recognition of the importance of this malady, and accurate statistics are not available. Bo duan,[1] who investigated the epidemic after its close, collected b means of a questionnaire sent to physicians, reports of about 8 cases and estimated that, in all, the epidemic comprised a total perhaps 2,500 cases.

Subsequent to this important event, poliomyelitis had not in Ne York City assumed serious proportions. In the years intervenin between 1907 and 1916, however, the city was by no means free fro the disease. Table A (Appendix) gives the number of cases b months, by boroughs, and for the city at large, for the years sin 1911, the first full year for which statistics are available. It wi be seen that the number of cases reported annually varied betwe 95 and 504. The average number of cases per 100,000 population p annum for the five years was 5.35.

Poliomyelitis was classified separately by months, by borough as a cause of death in 1914, and the deaths are given in the table f 1914 and 1915.

The prevalence of poliomyelitis in New York City from 1911 1916, with population and incidence rates per 100,000, are given the following table:

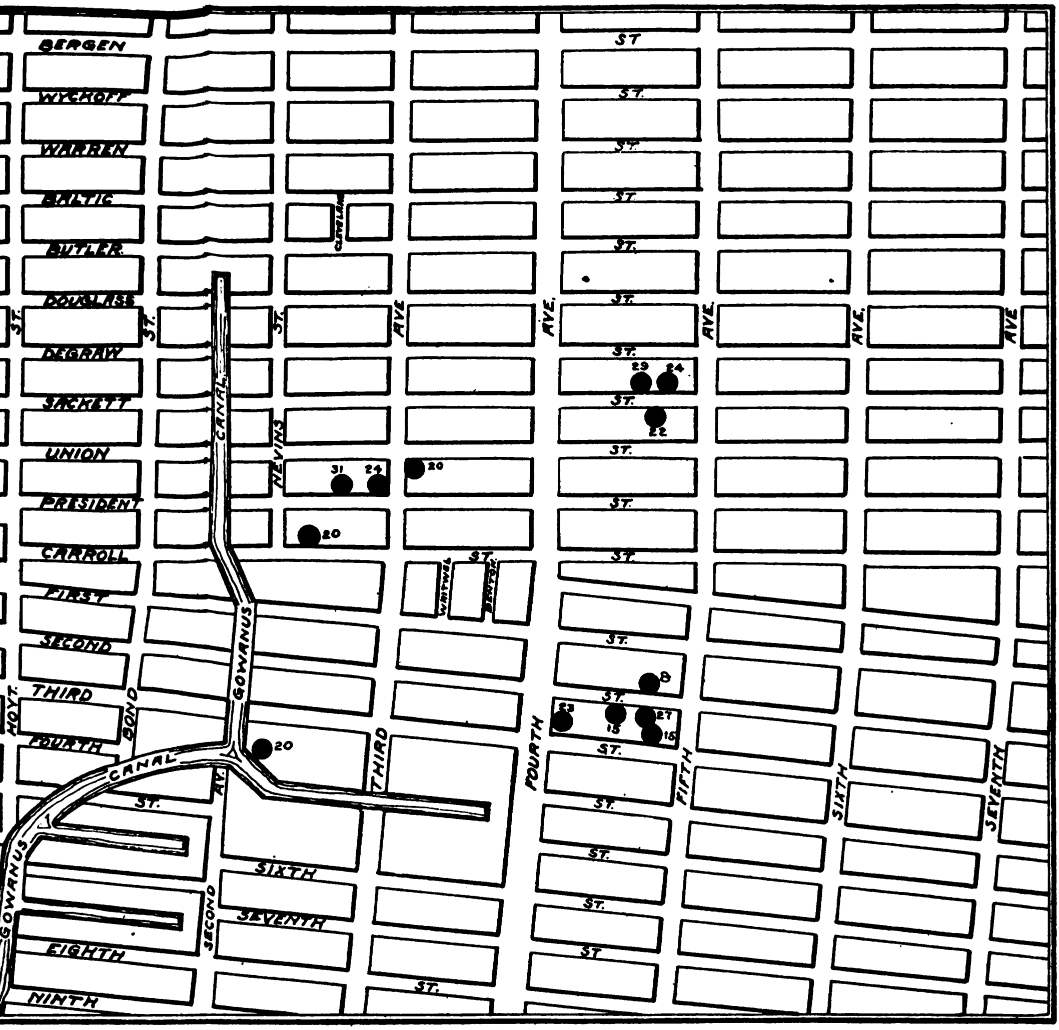
TABLE NO. 28.—*Poliomyelitis, New York City, 1911–1915.*

Year.	Number of cases.	Population, estimated.	Cases p 100,000 p ulation
1911	358	4,929,586	7
1912	504	5,064,237	9
1913	305	5,198,888	5
1914	129	5,333,539	2
1915	95	5,468,190	1
Average rate, 1911–1915	....	....	5

While the total number of cases each year and the average rate incidence for the five years may seem small, comparison of this ra with the rates of endemic prevalence in other parts of the Unit States does not bear out this view. The following table gives t average rates of prevalence per 100,000 for the period 1911–1915 those States in the United States in which the rates for the fiv year period are highest:

---

[1] See New York Collective Investigation Committee's Report, bibliography.



City, 1916. Map of district where epidemic began in Brooklyn, showing incidence of cases during month of Ma
dicated by dots; (b) numbers above dots refer to day of month (May) on which cases occurred.
ce page 87.)

TABLE No. 29.—*Poliomyelitis in United States, 1911–1915.*

Average number of cases per 100,000 population, 1911–1915, inclusive:	
California	5.74
Illinois	3.18
Indiana	3.18
Iowa	2.17
Massachusetts	5.91
Minnesota	3.75
Pennsylvania	2.07
Vermont	24.28
Virginia	7.85
Wisconsin	1.89
Average rate for group, weighted according to population	3.79

Included in this group are California and Vermont, both of which suffered from distinct epidemics during the period covered. Leaving these out of consideration, we find only Massachusetts and Virginia with higher endemic rates during the period covered than New York City. The average incidence for the whole group, including, as it does, the States showing the highest recorded prevalence, is markedly less than in New York City. However, it is to be noted that the morbidity records of New York City are in general more complete than State records, almost certainly more nearly complete than the records of this group taken as a whole.

ORIGIN OF THE EPIDEMIC IN NEW YORK CITY DURING 1916.

The early months of 1916 gave no warning of especial liability to the development of an epidemic. Only 13 cases were reported during the first four months of the year, a smaller number than during any corresponding period since the disease was made reportable. During the month of May only five cases were reported, a smaller number than the May average for the previous four years.

The epidemic began, so far as the facts are discoverable, about May 8, in that portion of Brooklyn lying immediately about the head of the old Gowanus Canal. The first two cases developed on May 8 and 9. One of these was in the center of what afterwards developed as the essential focus of the epidemic; the other, some distance away, in a sparsely settled district in South Brooklyn. On May 15, one week after the first case, four others developed, two in the immediate vicinity of the first case and two a mile or more away. May 17 another case developed near one of the more distant of the cases of May 15. On May 20 three cases developed, all in the immediate vicinity of the first case. By the end of May, 24 cases had

occurred, 14 of which were in the vicinity of the first case. The r
maining 10 cases were scattered throughout practically the whole c
the residential portion of the borough. The location of the firs
group of cases is shown graphically in the accompanying sketc
(map No. 10) of the area first attacked and also by the spotting c
the May cases on the larger map of cases for May and June fc
Brooklyn (map B, Appendix).

The area first attacked, lying, as has been said, immediately abou
the head of the old Gowanus Canal, is a combined residential an
industrial area. The residences are for the most part old. The
were apparently built for the occupancy of single families, but a
now used as tenements. In the neighborhood are numerous vacan
lots, and just to the south is a considerable territory covered by th
shops and sheds of ragpickers, junk dealers, and other handlers c
secondhand goods. In most of the residence blocks are to be foun
numerous small stores, Italian bakeries, laundries, and other sma
trades. Stables are rather common. Along the banks of the can
are lumber and brick yards, and other industries connected with th
rough and heavy freight conveyed by the barges using the canal.

Compared with the other residential parts of Brooklyn, the popu
lation is not notably dense and, compared with the crowded ten
ments of Manhattan, seems relatively sparse. The general sanita
tion of the area, as regards water supply, sewerage, street cleanin
refuse removal, and other factors of public sanitation, is not notabl
different from that of the surrounding territory or of the city as
whole. The most striking features of the neighborhood are th
vacant lots, the junk shops, the Italian population, and the swarn
of children to be seen in the streets.

Of the 24 cases occurring in May, 13 were of Italian parentag
2 of Russian or Polish, and the remainder American. All of th
Italian children, with one exception, were in the neighborhood firs
attacked. The cases occurring at a distance from the primary focu
were almost entirely of American descent.

By the end of May cases began to appear in the other borough
Five cases occurred in Manhattan Borough in the last week of th
month, although only one case had occurred in the previous thre
weeks. The Manhattan cases were scattered from below Fourt
Street up to One hundred and forty-fifth Street. Four of the si
May cases in Manhattan were in children of Italian parentage.

In the Borough of Queens one case occurred, just over the Brookly
boundary.. In the Borough of Richmond one case, an Italian chil
occurred in Rosebank, one of the villages on the northeastern sid
of the island. The Borough of the Bronx had no cases during Ma

By the end of May, therefore, the epidemic was well started i
Brooklyn, and cases had begun to appear in Manhattan, Queens, an

Richmond. The location of these cases is shown graphically in the accompanying map. (Map A, Appendix.)

Although 32 cases occurred in Greater New York during the month of May, only 4 cases were reported to the department of health, a number not in excess of the normal endemic prevalence and not sufficient to attract attention. Even had the total number of cases which actually occurred been promptly reported, they might well have been considered at the time as part of the normal endemic prevalence. Their relation to the subsequent train of events is, however, so unmistakable that their importance as the real original focus of epidemic conditions can not be doubted.

It is difficult to define accurately the significance of the large percentage of children of Italian parentage found in the early cases. This high percentage of Italians may be due to several causes. It may be due only to the fact that the epidemic happened to start in a portion of the city largely occupied by Italians; to an actual racial susceptibility to the disease; or to the fact that there is something in the environment or habits of life of Italians living in the city of New York which favors the spread of the disease. The fact of the preponderance of children of Italian parentage in early cases was observed in connection with the spread of the disease outside of New York City.

The excess of Italians among the first cases was observed early in the epidemic and gave rise to the suspicion that the disease might have been introduced in its epidemic form by immigrants recently arrived from Italy. The facts in this connection were carefully investigated by the immigration authorities of the port of New York, and the destination of all Italian immigrants entering for some months prior to the outbreak was reviewed. While there was evidence of recent immigration from Italy into the infected district, yet the chronology of events did not accord with the suspicion, and in view of the fact that poliomyelitis has rarely prevailed, so far as is known, in epidemic form in Italy, there seems no valid reason to attach to immigration any important direct connection with the origin of the outbreak.

In view of the fact that, after the first group of cases, all races seem to be attacked with equal intensity, it seems most probable that the beginning of the epidemic among Italians was without significance. The part played by persons from the infected district in spreading the disease outside the city will be discussed in another section.

COURSE OF THE EPIDEMIC.

CASES IN JUNE.

With the beginning of June the number of cases occurring in Brooklyn began markedly to increase. Seventeen cases are recorded

as having onsets on June 1. In view of the known tendency
group such events around well-remembered days, it is probable th
all of these cases did not occur exactly on June 1, but were scatter
over several days about that time. The cases in Brooklyn averag
about 8 per day for the first half of the month. Beginning abo
June 15 the number increased sharply, and for the last half of t
month averaged about 35 per day. The total number of onsets f
Brooklyn for the month of June was 646, as against 24 for the mont
of May.

The location of the June and subsequent cases for the vario
boroughs is shown on the accompanying series of maps. (Ma
B to U, Appendix.) It is of interest to note that every importa
group of cases occurring in June, with one exception, was for
shadowed by the cases occurring in May. The June cases occurr
principally in the territory immediately surrounding the primar
focus and in the territory to the north and south of the primar
focus, along the main lines of traffic.

In Manhattan the number of cases increased steadily during Jun
though not so rapidly as in Brooklyn. An average of one per da
occurred during the first half of the month, and an average of fou
per day during the last half. The distribution in Manhattan is muc
more irregular than in Brooklyn. A large group of cases develope
on the lower East Side and a considerable number about the upp
end of Central Park, in what is known as the Harlem Italian distric
In the Borough of Manhattan 79 cases developed in June.

Richmond Borough showed the most rapid rise, in proportion
population, of any of the boroughs. Thirty-six cases occurred
June, scattered principally through the towns along the eastern an
northern sides of the island.

Queens Borough showed only 2 cases during the first half of th
month, but the number increased rapidly after June 15, 11 occurrin
during the latter half.

The first case in Bronx Borough developed on June 18, and 1
cases altogether developed before the end of the month.

By the end of June epidemic conditions were established in all th
boroughs, and in Brooklyn and Richmond the epidemic had assume
serious proportions.

CASES IN JULY.

July witnessed a steady increase in the number of cases developin
in the city, and in all boroughs, except Richmond, where the epi
demic reached its crest about July 15, and began after that to declin

In Brooklyn the July cases were widely scattered. The principa
grouping was largely in the northern sections, extending out towar
the northeast. The number of cases in the territory about the pr

mary focus began to diminish during the month. In Brooklyn 2,275 cases occurred during July.

In Manhattan the number of cases increased very rapidly during the month, the cases being located principally on the lower East Side and in the Harlem Italian district. During the month there developed 893 cases. By the end of the month the disease had appeared in practically every part of Manhattan.

The Bronx showed a considerable number of cases in the eastern half of the borough, the western half being entirely free from the disease. One hundred and eighty-four cases developed in the Bronx during July.

In Queens the disease was widely scattered during the month. In Long Island City, located in the extreme western edge of the borough, just across the East River from Manhattan, and connected with it by a ferry and bridge, occurred an interesting clumping of cases, while the main development of cases was along the center of the borough, north and south of the Long Island Railroad, which divides the borough into two almost equal halves. This area constitutes a direct extension of the disease from the affected center in Brooklyn, with which it is continuous. During July 517 cases developed in Queens Borough.

During July cases of poliomyelitis appeared in practically every part of the borough of Richmond, though the main prevalence was still in the communities along the northern and eastern sides of the island. The disease reached its crest in Richmond about July 15, and began to decline. During the month there occurred 197 cases.

CASES IN AUGUST.

The first week of August marked the crest of the epidemic for the city as a whole, and individually for the boroughs of Manhattan, Brooklyn, and Queens. The Bronx reached its highest point during the week ending August 12, one week later than Manhattan, Brooklyn, and Queens.

For the whole city August 1st was the highest single day, with 247 onsets. July 31 was the next highest, with 237. August 1 was the highest day for Brooklyn, Manhattan, and the Bronx, and the second highest day for Queens. Richmond's highest day occurred as early as July 13, and Queens' highest on July 31.

The distribution of the August cases in Brooklyn is of interest principally in showing the decline in the number of cases in the territory first attacked, and the increase in the number of cases in the territory farthest from the primary focus. The territory about the head of Gowanus Canal, where the epidemic apparently began, was practically free from the disease during August.

In Manhattan there was a significant decline in the number cases along the lower east side, and an increase in the middle e and west sides, as well as in the extreme northern parts of borough.

The prevalence of the disease in the Bronx and Queens dur August was not striking in its distribution. The difficulty in cating cases in Queens, owing to the confusion of street numb rendered impossible the preparation of any accurate spot map fr the material available, and no spot maps by months for that borou therefore, are available for study.

The August cases in the borough of Richmond were principa along the southern and western boundaries of the island.

The number of cases by boroughs for August was as follo Manhattan, 1,293; Bronx, 329; Brooklyn, 1,246: Queens, 578; a Richmond, 49.

CASES IN SEPTEMBER.

By the 1st of September the number of cases was declining ve rapidly in all boroughs. The total number of cases developing the city for the week ending September 2 was 392, as against 1, for the week ending August 5.

The distribution of the September cases was of interest in that t areas most severely attacked in July were almost entirely free fr the disease during September. In Brooklyn most of the Septem cases were in the northeastern section. In Manhattan cases were g erally scattered, except for the lower East Side, which was alm entirely free. The Bronx September cases were generally distribut The few cases, 13 in number, occurring in Richmond Borough w generally distributed throughout the island.

During the month cases occurred in the various boroughs as f lows: Manhattan, 339; Brooklyn, 207; Bronx, 137; Queens, 1 Richmond, 13; the city as a whole, 821.

CASES IN OCTOBER.

During the month of October only 136 cases occurred in the wh city, distributed as follows: Manhattan, 63; Bronx, 28; Brookl 26; Queens, 29; and Richmond, none.

The end of October marked the practical end of the epidemic, a statistical studies were not continued after that time.

REPORTING OF CASES.

As has already been stated, only a few of the cases occurring May were reported to the department of health until later in t epidemic. Attention was first attracted to the subject on June 8, wh four cases were reported. Investigations were immediately start disclosing the presence of many unreported cases, and on June 17, the existence of epidemic conditions was publicly announced. Although only 34 cases had been reported prior to that time, 188 cases had actually occurred, as shown by subsequent studies.

With the recognition of the importance of the subject, physicians began to report cases more promptly, and in the early days of July far more cases were reported than were actually occurring at that time, the excess being made up of old cases previously unreported. With the organization of energetic measures by the department of health and the immediate investigation of all reported cases, reporting became still more complete and prompt, and as will be shown later, the time elapsing between onset and report was reduced from something like four weeks to about as many days.

The number of reported cases increased rapidly after the announcement of the seriousness of the situation on June 17, reaching a maximum on August 3, when 217 cases were reported.

TABLES AND CHARTS.

The course of the epidemic is shown statistically and graphically by the tables and charts which are presented. Table B (appendix) gives the number of onsets by days for each borough and for the city as a whole. Table C (appendix) gives the number of reported cases by days, by boroughs, and for the city as a whole. Table D (appendix) gives the number of onsets by weeks, by boroughs, and for the city, with the number of cases per 100,000 population, and cumulative rates by weeks. Chart No. 6 gives graphically the number of onsets and reported cases by days for the city. Chart No. 7 gives the number of cases by weeks for the boroughs and for the city. Chart No. 8 gives graphically the rate of onset per 100,000 by weeks, by boroughs, and for the city. Chart No. 9 gives graphically the cumulative rates of onset by weeks, by boroughs, and for the city.

INCIDENCE OF POLIOMYELITIS IN NEW YORK CITY.

The epidemic of poliomyelitis in New York City and the surrounding territory, starting as it did so definitely with a small group of cases in the center of an enormous unit of population, affords unique opportunity for the study of the mass movement of the disease.

In the following studies the populations used in the computations are those furnished by the New York State census for 1915. These differ from the estimates made by the United States Bureau of the Census, based on the census of 1910. In view of the fact, however, that the State census gives populations by small divisions—assembly districts, precincts, and even individual blocks—for the entire city, its usefulness in a study of this kind is so great as to make it seem advisable to use the figures, even though they do not agree exactly with those of the United States census, which are the recognize standards for vital statistics. In addition, it is felt that th very great changes in the population of New York City followin the stoppage of immigration and the departure of thousands of r servists on the outbreak of the European war, together with th

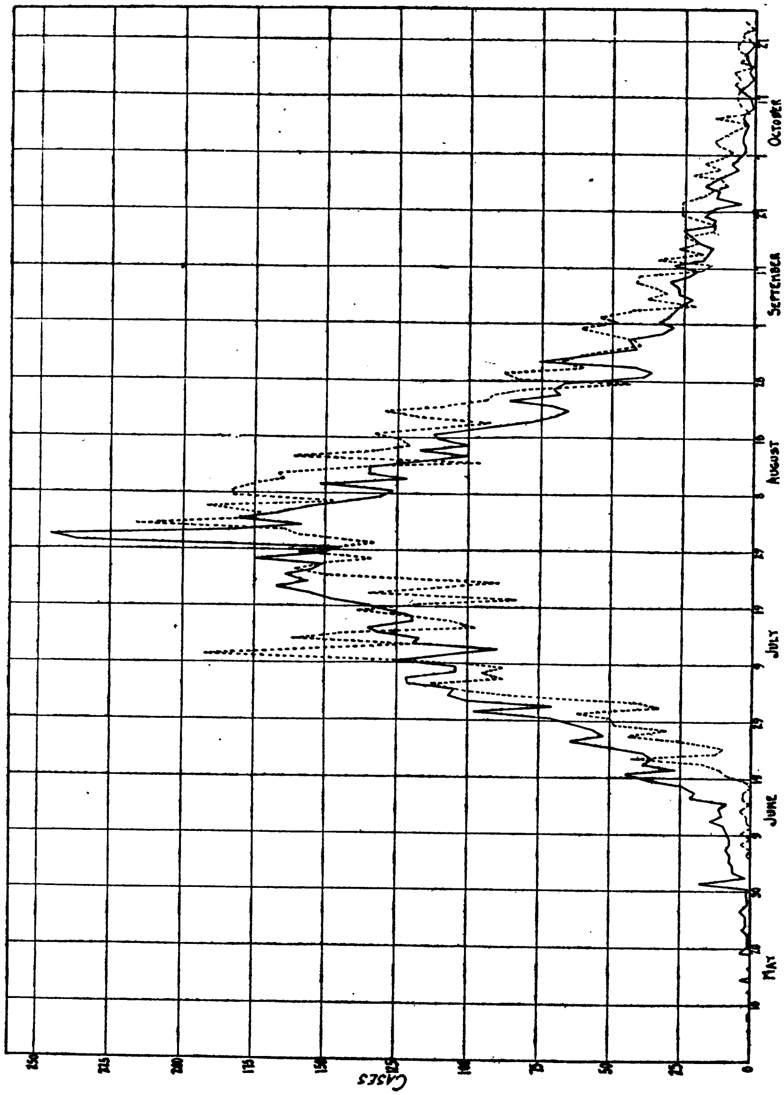


CHART No. 6.—Poliomyelitis, New York City, 1916. Incidence of cases, by days, according to: (a) Date of

accelerated movement of people from the more densely crowde parts of Manhattan to the more thinly settled outlying borough render the estimates of the United States Census Bureau, based o the 1910 census enumeration, less accurate than would ordinaril be the case.

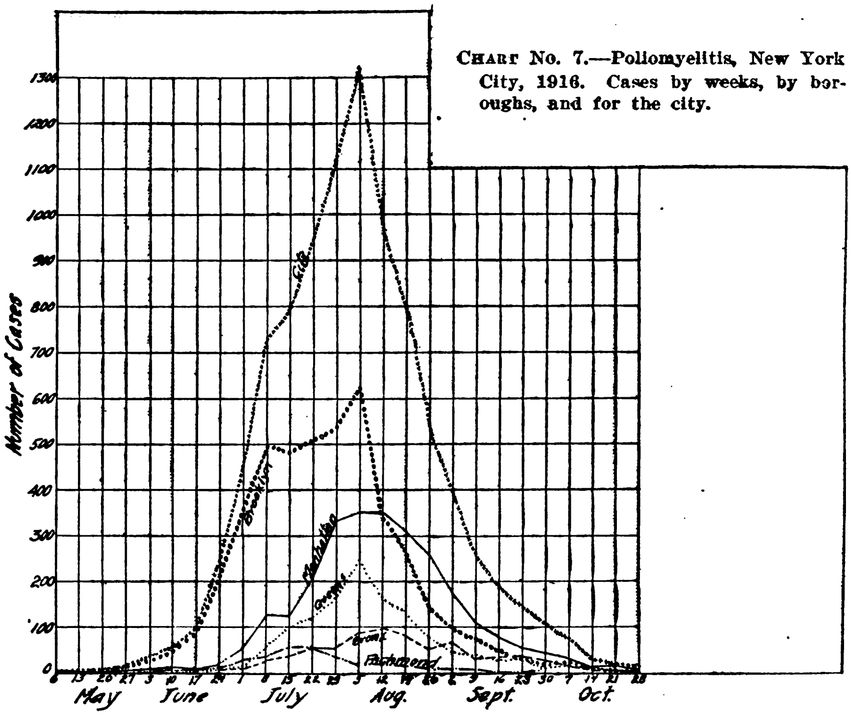


CHART No. 7.—Poliomyelitis, New York City, 1916. Cases by weeks, by boroughs, and for the city.

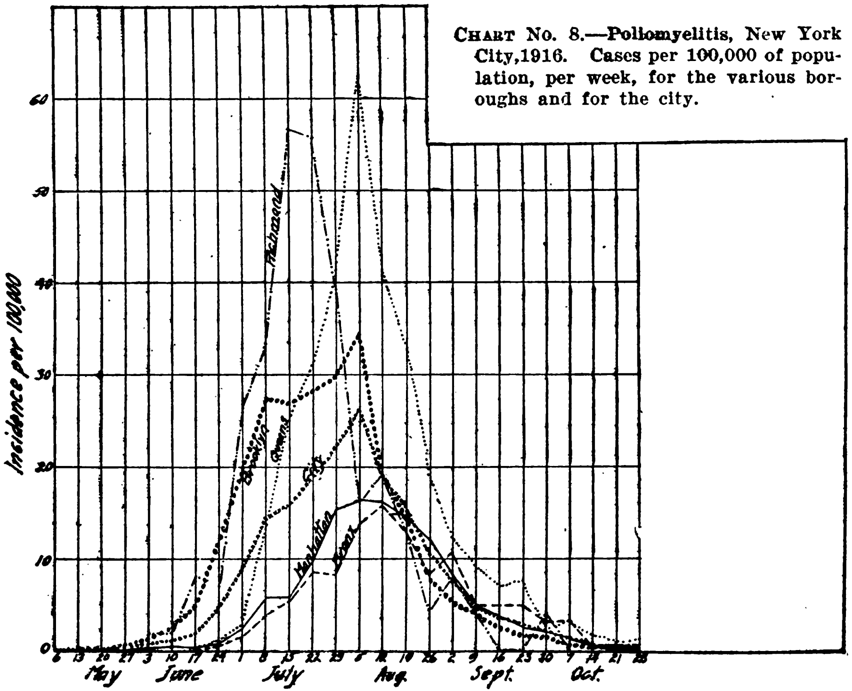
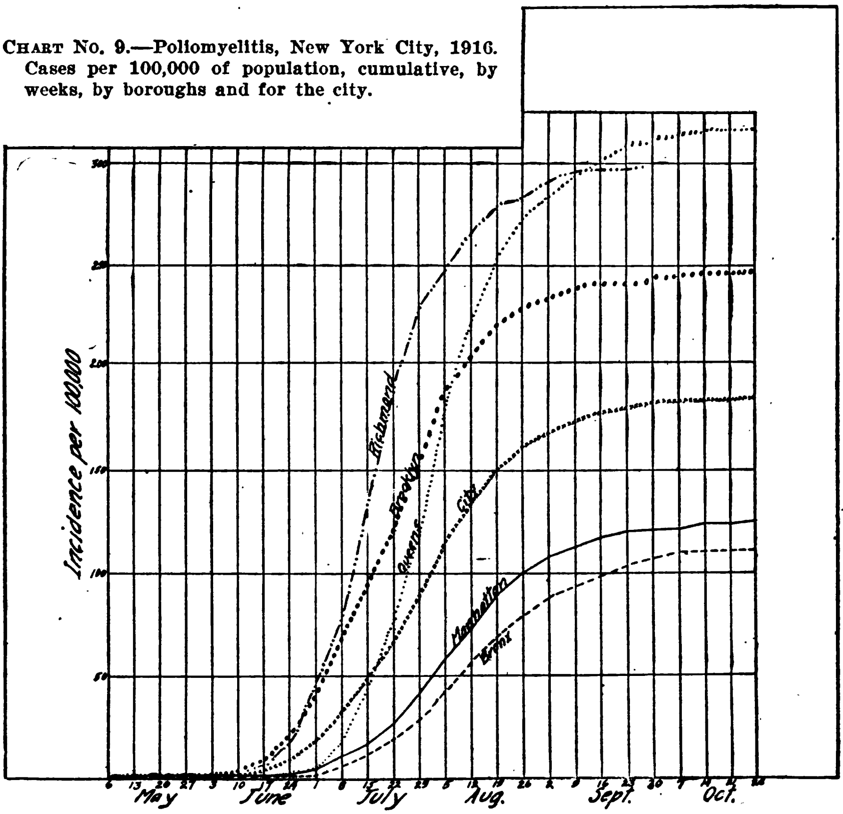


CHART No. 8.—Poliomyelitis, New York City, 1916. Cases per 100,000 of population, per week, for the various boroughs and for the city.

CHART No. 9.—Poliomyelitis, New York City, 1916. Cases per 100,000 of population, cumulative, by weeks, by boroughs and for the city.



INCIDENCE BY BOROUGHS.

The number of cases occurring, with the rates per 100,000 in the various boroughs, for the period from May 1 to November 1, 1916 are shown in the following table:

TABLE No. 30.—*Poliomyelitis, New York City, 1916, incidence by boroughs.*

Borough.	Population (State census 1915).	Number of cases.	Incidence rate per 100,000.
Manhattan	2,137,747	2,672	125.
Bronx	615,600	690	112.
Brooklyn	1,798,513	4,424	246.
Queens	396,727	1,263	318.
Richmond	98,634	296	300.
The city	5,047,221	9,345	185.

The differences in prevalence in the various boroughs are of interest in that Brooklyn, where the epidemic started and where opportunities for spread would appear to have been most favorable ad a lower rate of incidence than the adjoining Borough of Queens nd also lower than Richmond. It should be noted that in both ueens and Richmond the percentage of population living under uburban conditions is considerably larger than in the other boroughs.

The low rates in Manhattan and The Bronx are also of interest. uring the early part of the epidemic these two boroughs ran almost xactly parallel week by week in their rates of incidence. The con-itions in the two boroughs are quite different. Manhattan, as has lready been stated, exhibits the most densely crowded conditions of ife in the city, while The Bronx has large vacant areas, and modern ousing conditions for a large part of the population.

It is of interest in this connection to compare the rates of inci-ence in the various boroughs during the epidemic of 1916 with the ndemic prevalence by boroughs for the period since 1911. The ollowing table shows the number of cases and the incidence per 00,000 for the five-year period 1911–1915, inclusive:

TABLE NO. 31.—*Incidence of poliomyelitis, by boroughs, New York City, 1911–1915, inclusive.*

Borough.	Cases by years.					Total cases.	Average annual rate, 1911–1915, per 100,000.
	1911	1912	1913	1914	1915		
anhattan	216	350	160	80	57	863	6.95
ronx	49	52	62	28	10	201	7.96
rooklyn	66	78	75	14	21	254	2.85
ueens	12	18	7	6	7	50	3.06
ichmond	15	6	1	1	0	23	5.00

A comparison of this table with the table of prevalence for 1916 hows that Manhattan and the Bronx, with the highest endemic revalence for the previous five years, had the least incidence of oliomyelitis during 1916. The other three boroughs, with lower ndemic prevalence, showed the highest epidemic incidence.

A study of prevalence in the various boroughs for the three years rior to 1916 shows still more interesting relationships.

ABLE NO. 32.—*Incidence of poliomyelitis, by boroughs, New York City, 1913–1915, inclusive, and 1916, with rates per 100,000.*

Borough.	Cases by years.			Total cases, 1913–1915.	Average rate, 1913–1915.	Rate, 1916.
	1913	1914	1915			
anhattan	160	80	57	297	3.80	125.0
ronx	62	28	10	100	6.30	112.1
rooklyn	75	14	21	110	2.00	246.0
ueens	7	6	7	20	1.97	318.3
ichmond	1	1	0	2	.71	300.0

It will be seen from the above table that the prevalence in 1916 varied almost inversely in proportion to the endemic prevalence in the previous three years. Those boroughs which had least poliomyelitis in the previous three years had most in 1916. It is to be regretted in this connection that the figures for prevalence in the boroughs during the epidemic of 1907 are not available for comparison.

DISTRIBUTION BY ASSEMBLY DISTRICTS.

A comparison of the spot maps, showing the location of the cases occurring during the epidemic in the various boroughs, with the maps showing the distribution of population within the boroughs (see maps in appendix) would seem to indicate that in general the distribution of cases corresponds quite accurately with the distribution of population. In order to determine just how accurately the distribution of cases corresponded to the distribution of population, the cases have been arranged according to the assembly district in which they occurred, and the number of cases occurring in each 100,000 of population computed by assembly districts.

The assembly district was chosen for this purpose by reason of the fact that it constitutes a unit of convenient size, the population for which was enumerated in 1915 by the State census; moreover, its lines are drawn irregularly, without regard to sanitary conditions. By reason of the fact that the addresses of a number of cases are defective, certain of them could not be located with sufficient accuracy to determine in which assembly district they occurred. These cases have been omitted from consideration, and for that reason the number of cases appearing in the tabulations by assembly districts is smaller than that used in certain other tabulations. The number of cases omitted is not large, however, and does not in all probability affect the tabulations in any significant way. By reason of the fact that the Borough of Richmond is all included in one assembly district, it is omitted in this tabulation. The following table (Table No. 33) shows the number of cases of poliomyelitis in each assembly district of Manhattan, the Bronx, Brooklyn, and Queens, the population of each district, and the number of cases per 100,000 population:

TABLE No. 33.—*Poliomyelitis, New York City, 1916—Incidence of cases by assembly districts.*

Assembly district.	Population, 1915.	Cases.	Rate per 100,000.
Borough of Manhattan:			
1	60,465	97	160.4
2	82,693	140	169.3
3	79,404	75	94.4
4	83,847	91	108.5
5	45,146	110	234.6
6	87,168	85	97.5
7	43,212	86	199.0
8	93,422	92	98.5
9	45,842	34	74.2
10	82,406	77	93.4
11	47,028	71	150.9
12	72,650	171	235.4
13	47,271	106	224.2
14	56,496	81	143.4
15	64,739	53	81.9
16	51,344	58	112.9
17	62,793	54	86.0
18	69,268	78	112.6
19	87,870	109	124.0
20	63,385	79	124.6
21	72,145	55	76.2
22	49,313	42	85.2
23	163,342	123	75.3
24	81,344	108	132.8
25	39,280	71	180.7
26	83,163	88	108.8
27	44,704	28	62.6
28	76,449	95	124.3
29	51,949	39	75.1
30	85,342	90	105.4
31	64,269	50	77.8
Total	....	2,536	....
Borough of the Bronx:			
30	25,076	42	167.5
32	171,093	214	125.1
33	91,403	61	66.7
34	190,307	231	121.4
35	137,721	88	63.9
	....	658	....
Borough of Brooklyn:			
1	48,248	90	186.6
2	46,911	166	353.8
3	59,102	175	296.1
4	60,148	156	259.4
5	57,433	67	116.6
6	71,438	217	303.8
7	62,795	210	334.5
8	55,185	174	315.3
9	117,734	357	303.2
10	53,477	79	147.7
11	57,221	108	188.7
12	62,528	100	159.9
13	64,379	154	239.2
14	67,649	179	264.6
15	59,710	83	139.0
16	143,860	441	306.5
17	51,686	82	158.6
18	112,606	169	150.1
19	69,847	212	303.5
20	51,133	83	162.3
21	74,267	248	334.0
22	158,087	232	146.7
23	193,069	427	221.2
Total	....	4,209	....
Borough of Queens:			
1	73,812	171	231.7
2	75,923	239	314.8
3	135,195	359	265.6
4	111,797	431	385.5
Total	....	1,200	....

The rate per 100,000 varies from 62.6 for the twenty-seventh assembly district of Manhattan to 385.5 for the fourth assembly district of Queens. Within the various boroughs the variations are not nearly so marked. In Brooklyn the variation is between 117 for the lowest to 353.8 for the highest; in Manhattan between 62.6 and 235.4; in Queens between 231.7 and 385.5; while in the Bronx the rates vary only between 63.9 and 167.5.

The variations in incidence as exhibited by the tabulations appear at first glance to be extreme. It has seemed desirable, therefore, to study the variations in incidence of other common communicable diseases in population groups of comparable size. Unfortunately material for this comparison is not abundant. Through the courtesy of the health department of Newark, N. J., a table of incidence by wards of 8,241 cases of measles occurring in that city in the spring of 1916 is available. There is also available a table of the incidence of diphtheria and scarlet fever by wards in the city of Chicago for the year 1910. An inspection of the various rates of incidence shows th measles in the wards of Newark displays considerably wider vari tions in incidence than does poliomyelitis in the assembly districts Brooklyn, while the variations in incidence of diphtheria and scarl fever in Chicago are, to all appearances, of approximately the san degree as those of poliomyelitis in New York City.

COEFFICIENT OF DISPERSION.

It has seemed advisable, however, to have a definite measure of t degree of variation between the items of the different series of rate more definite than that afforded by mere inspection of the figure In order to secure such an expression the "coefficient of dispersion has been computed for the four series of rates: Measles in Newar scarlet fever and diphtheria in Chicago, and poliomyelitis Brooklyn.

The coefficient of dispersion[1] is in general use among statisticia to express the degree of variation between the items of any give series. It is evident, to consider the series of rates for measles b wards in Newark, for example, that if the rates of all the wards we the same, there would be no variation, and the coefficient would b zero. If the rates varied very widely the dispersion would be greate and the coefficient of dispersion would approach unity. The coeff cient of dispersion, therefore, appears to be a suitable means for e pressing the relative variations between the four series of rates und consideration.

The cofficient of dispersion is computed by finding the arithmetic average of the items in the series to be considered and computing t deviations of each of the items from this average. These deviatio are then squared, the sum of the squares is obtained, divided by t number of items, and the square root of the quotient is extracte This result is known technically as the standard deviation. T standard deviation is divided by the arithmetical average of the ite to obtain the coefficient of dispersion.

Computed according to this method, the coefficients of dispersio for the various series of rates were as follows:

TABLE NO. 34.—*Coefficient of dispersion for certain diseases in certain citie*

	Coefficient of dispersio
Scarlet fever by wards, Chicago, 1910	0.3
Diphtheria by wards, Chicago, 1910	.3
Measles by wards, Newark, 1916	.8
Poliomyelitis by assembly districts, Brooklyn, 1916	.3

---

[1] For a discussion of the coefficient of dispersion, see King: Elements of Statisti Method, McMillan, 1915, or some other similar treatise.

The higher coefficient of dispersion for measles is in all probability due, in part at least, to the fact that the wards of Newark constitute considerably smaller population units than the wards of Chicago or the assembly districts of Brooklyn. In general, the smaller the unit of population considered the greater the variation to be expected in rates.

The comparison between diphtheria and scarlet fever in Chicago and poliomyelitis in Brooklyn, however, is between population units of approximately the same magnitude. The very close agreement between the three diseases in respect to the regularity of incidence, as shown by the coefficients of dispersion, is of considerable importance.

In Tables Nos. 35 and 36 are shown the population and number of cases of diphtheria and scarlet fever for each ward in Chicago in 1910, together with the rate per 100,000. The same facts are given regarding measles in Newark and poliomyelitis in Brooklyn in 1916.

TABLE No. 35.—*Incidence of scarlet fever and diphtheria, by wards, city of Chicago, 1910.*

Wards.	Population, 1910.	Diphtheria.			Scarlet fever.		
		Cases.	Rate per 100,000.	Percentage of average rate.	Cases.	Rate per 100,000.	Percentage of average rate.
1	29,528	80	270.9	75	50	169.3	58
2	42,801	130	303.8	84	65	151.8	52
3	46,135	103	223.3	61	106	229.8	78
4	49,650	217	437.1	120	146	294.1	100
5	57,131	183	320.4	88	154	269.6	92
6	75,121	146	194.4	54	241	329.8	112
7	90,423	256	283.2	78	241	266.5	91
8	65,810	137	208.2	57	310	471.2	160
9	44,801	354	790.1	218	277	618.3	210
10	51,707	308	595.7	164	247	477.8	162
11	57,664	294	509.9	140	141	244.5	83
12	91,521	260	284.1	78	186	203.3	69
13	58,721	175	298.0	82	170	289.5	98
14	52,770	188	356.3	98	145	274.8	93
15	60,438	202	334.3	92	189	312.8	106
16	65,223	234	358.8	99	114	174.8	59
17	70,009	289	412.8	114	142	202.8	69
18	26,137	116	443.9	122	63	241.1	82
19	58,023	358	617.0	170	254	437.7	149
20	61,708	256	414.9	114	240	389.0	132
21	47,906	158	329.8	91	94	196.2	67
22	49,324	300	608.4	167	126	255.5	87
23	44,320	175	394.9	109	118	266.3	90
24	52,428	179	341.5	94	134	255.6	87
25	99,696	265	265.8	73	210	210.7	72
26	74,793	298	398.4	110	256	342.3	116
27	112,793	489	433.6	119	462	409.6	139
28	68,183	310	454.7	125	182	267.0	91
29	81,985	246	300.0	83	193	235.4	80
30	51,308	173	336.7	93	153	297.8	101
31	78,571	176	224.0	62	180	229.1	78
32	70,408	197	279.8	77	154	218.7	74
33	70,841	174	245.6	68	240	338.8	115
34	67,769	240	354.2	97	183	270.1	92
35	59,547	164	275.5	76	186	312.4	106
Hospital		91			69		
Not located		18			8		
Total	2,185,283	7,939			6,429		
Average rates			363.3			294.2	

TABLE No. 36.—*Incidence of measles by wards, Newark, N. J., epidemic, spring of 1916.*

Wards.	Population, United States census, 1910.	Estimated population July 1, 1916.	Cases of measles.	Incidence rate per 100,000.	Ratio to average rate.
1	13,919	16,380	1,176	7,180	356
2	13,736	16,160	186	1,151	57
3	36,910	43,440	1,061	2,443	121
4	13,756	16,190	189	1,167	58
5	17,970	21,150	124	586	29
6	20,944	24,640	369	1,498	74
7	22,474	26,450	331	1,251	62
8	20,166	23,730	707	2,979	148
9	15,805	18,600	531	2,855	142
10	24,430	28,750	246	856	42
11	22,408	26,370	264	1,001	50
12	19,789	23,270	178	765	38
13	18,951	22,300	1,084	4,862	241
14	35,828	42,160	899	2,132	106
15	19,622	23,090	332	1,438	71
16	30,761	36,200	564	1,558	77
City	347,469	408,894	8,241	2,016	100

The computation of the coefficient of dispersion for poliomyelitis in Brooklyn is given in detail (Table No. 37), those for the other diseases being omitted for lack of space.

TABLE No. 37.—*Coefficient of dispersion, distribution of poliomyelitis, Brooklyn, 1916.*

Assembly districts.	Incidence rates per 100,000.	Deviation of rate from average.	Square of deviation.	Assembly districts.	Incidence rates per 100,000.	Deviation of rate from average.	Square of deviation.
1	186	48	2,304	14	265	31	961
2	354	120	14,400	15	139	95	9,026
3	296	62	3,844	16	306	72	5,184
4	259	25	625	17	159	75	5,625
5	117	117	13,690	18	150	84	7,056
6	304	70	4,900	19	304	70	4,900
7	334	100	10,000	20	162	72	5,184
8	315	81	6,561	21	334	100	10,000
9	303	69	4,762	22	147	87	7,569
10	148	86	7,396	23	221	13	169
11	189	45	2,025				
12	160	74	5,476	Total	5,391		131,682
13	239	5	25	Average	234		

$$\Sigma x^2 = 131,682$$

$$\frac{\Sigma x^2}{n} = 5,726$$

$$\delta = \sqrt{\frac{\Sigma x^2}{n}} = 75.6$$

$$\frac{\delta}{\alpha} = \frac{75.6}{234} = .323 = \text{Coefficient of Dispersion.}$$

INCIDENCE OF POLIOMYELITIS IN CHILD POPULATION.

In view of the well-known tendency of poliomyelitis to attack almost exclusively persons under 10 years of age, and in view of the known differences in the distribution of child population between the various boroughs, and between different parts of the same borough, it was thought that these differences in child population might, in part at least, explain the variations in incidence previously referred to.

Unfortunately the last statistics regarding the age distribution of the general population of New York City are those of the Federal census of 1910. It seems, however, fair to assume that the percentage of child population in the various boroughs and their subdivisions has not changed markedly since the 1910 census. Estimates of child population—that is, population under 10 years of age—have been made, therefore, by assuming in the population units as given by the State census of 1915, the same percentages of persons under 10 as were found in the United States census of 1910. The incidence of poliomyelitis per 100,000 estimated population under 10 for the several assembly districts of Manhattan and Brooklyn has been computed on this basis, and is given in Tables Nos. 38 and 39.

TABLE NO. 38.—*Poliomyelitis, New York City, 1916—Incidence of cases per 100,000 of estimated population under 10 years of age, by assembly districts.*

BOROUGH OF MANHATTAN.

Assembly district.	Population, 1915.	Per cent under 10, 1910 census.	Estimated population under 10 in 1915.	Cases.	Rate per 100,000 population under 10 years of age.
1	60,465	20.8	12,570	97	771.6
2	82,693	22.3	18,440	140	759.2
3	79,404	22.0	17,450	75	429.8
4	83,847	25.2	21,120	91	430.9
5	45,146	18.4	8,310	110	1,323.6
6	87,168	23.2	20,220	85	420.4
7	43,212	14.5	6,270	86	1,371.6
8	93,422	22.2	20,740	92	443.6
9	45,842	17.2	7,880	34	431.0
10	82,406	20.1	16,560	77	465.0
11	47,028	18.2	8,560	71	829.4
12	72,650	21.3	15,460	171	1,106.0
13	47,271	19.2	9,080	106	1,167.3
14	56,496	17.4	9,830	81	824.0
15	64,739	9.4	6,080	53	871.8
16	51,344	16.1	8,260	58	702.2
17	62,793	11.4	7,160	54	754.3
18	69,268	21.7	15,030	78	519.0
19	87,870	12.7	11,150	109	977.6
20	63,385	21.5	13,630	79	579.6
21	72,145	12.5	9,020	55	609.8
22	49,313	18.1	8,930	42	471.0
23	163,342	16.0	26,140	123	470.6
24	81,344	27.2	22,120	108	488.3
25	39,280	8.5	3,340	71	2,125.6
26	83,163	20.5	17,050	88	516.1
27	44,704	6.3	2,820	28	992.9
28	76,449	24.2	18,500	95	513.5
29	51,947	12.2	6,340	39	615.2
30	85,342	21.3	18,180	90	495.0
31	64,269	11.8	7,580	50	659.6

TABLE No. 39.—*Poliomyelitis, New York City, 1916.—Incidence of cases per 100,000 of estimated population under 10 years of age, by assembly districts.*

BOROUGH OF BROOKLYN.

Assembly district.	Population, 1915.	Per cent under 10, 1910 census.	Estimated population under 10 in 1915.	Cases.	Rate per 100,000 population under 10 years of age.
1	48,248	13.5	6,510	90	1,382.3
2	46,911	21.7	10,190	166	1,629.3
3	59,102	23.3	13,770	175	1,270.8
4	60,148	18.3	11,010	156	1,416.9
5	57,433	13.9	7,984	67	839.2
6	71,438	22.6	16,140	217	1,344.2
7	62,795	24.6	15,460	210	1,358.3
8	55,185	22.1	12,200	174	1,426.1
9	117,734	22.3	26,250	357	1,360.0
10	53,477	13.0	6,950	79	1,136.7
11	57,221	16.9	9,680	108	1,115.7
12	62,528	14.4	9,000	100	1,111.1
13	64,379	25.8	16,610	154	927.1
14	67,649	23.5	15,890	179	1,126.4
15	59,710	22.7	13,550	83	612.6
16	143,860	21.6	31,080	441	1,418.9
17	51,686	12.5	6,460	82	1,269.4
18	112,606	16.5	18,580	169	909.6
19	69,847	24.0	16,760	212	1,264.8
20	51,133	16.1	8,230	83	1,007.4
21	74,267	25.7	19,080	248	1,299.6
22	158,087	24.0	37,940	232	611.6
23	193,069	28.3	54,620	427	781.8

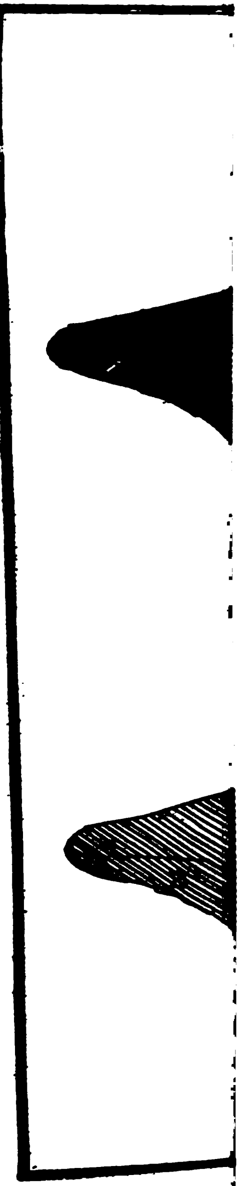
In general the results of this computation are not strikingly different from the rates of incidence in the general population. The variations between different districts are somewhat less than when the general population is used as the basis of computation, and the distribution of the areas of highest incidences is somewhat different. This difference for Manhattan is shown by the accompanying map (map No. 11), which shows graphically the incidence by assembly districts for the general population and for the population under 10.

CONCLUSION.

From the above studies of the general incidence of poliomyelitis in New York City, it may be concluded that the disease in general prevailed most severely in those boroughs which had had the lowest endemic prevalence during the previous three years. Within the various boroughs the disease was distributed very closely in accord with the distribution of population. No large areas of the city were notably spared, and the general distribution was about as even as would have been expected from an equally widespread epidemic of diphtheria, scarlet fever, measles, or other similar communicable disease.

SPREAD OF THE EPIDEMIC.

As has already been stated, even the most casual study of the location of cases occurring during the course of the epidemic shows striking changes in the points of maximum prevalence as the epidemic



advanced. It has seemed advisable to determine as accurately as possible the direction and velocity of this movement of the epidemic wave. For this purpose special studies of incidence have been made for the Borough of Brooklyn. Brooklyn was selected for this study by reason of the fact that the time and place of the origin of epidemic spread could be determined with considerable accuracy, and also that the spread in Brooklyn was continuous through a large and fairly homogeneous population.

The chronology of cases, as tabulated by weeks by assembly districts (Table E, appendix), gives some indications of the variations in chronology in different parts of the city. The maximum number of cases per week, for example, was reached during the week ending July 1 in some of the districts immediately adjacent to the primary focus, and not until the week of August 5 in some of the more distant districts. This table is defective for this purpose, however, for two reasons. The assembly district, while admirably adapted to studies of general incidence, is too irregular in shape, and too variable in size for use in studying the course of the epidemic wave. In addition, the week of maximum prevalence is, for the purpose desired, not a sufficiently definite point in the course of the epidemic. The tendency to group the time of onset about easily remembered dates, such as the 4th of July or the 1st or 15th of a month, results in the formation of peaks in the curve of prevalence which have no real relation to the course of the epidemic.

In order to study the direction and velocity of the epidemic wave in Brooklyn, therefore, the borough was divided into concentric zones, using the first epidemic focus (the intersection of Third Avenue and Carroll Street being the point actually selected) as a center and describing circles of respectively 1, 2, 3, 4, 5, and 6 miles in radius as boundaries of the zones.

The point chosen for comparison of chronological incidence between the various zones was the day of occurrence of the median or midcase of the epidemic in each zone, that is the day before and after which the same number of cases occurred in the zone. This half-way point is obviously a fixed point in the epidemic and not subject to such accidental variation as the period of maximum incidence. It is, therefore, used in all studies of comparative chronology in this report. It is determined by taking the total number of cases occurring in the area under consideration, counting from the beginning of the epidemic, and finding the day on which the number of cases reached half the final total.

Populations of the zones were computed from the precinct populations as given by the State census of 1915, counting all of a precinct in a zone where one-half or more lay within the boundary. The error in this method is not large as the individual precinct is not a large

unit of population in comparison with a zone, as taken in th
study.

The results of this computation, showing in each zone the nu
ber of cases by weeks, the rate of incidence per 100,000, and the mi
point of the epidemic are given in Table F (appendix), and m
be summarized as follows:

TABLE NO. 40.—*Incidence of poliomyelitis, by 1-mile zones from the epiden
focus, Brooklyn, 1916.*

Zones.	Population.	Number cases.	Rate per 100,000.	Date midca
I	198,014	479	241.9	July
II	277,671	672	242.0	July
III	439,861	1,113	253.1	July
IV	473,653	1,107	233.7	July
V	254,435	505	198.5	July
VI	154,879	343	221.4	Aug.
Total	1,798,513	4,219	....	July

From the table it will readily be seen that the epidemic wa
starting about the corner of Third Avenue and Carroll Stre
progressed radially from the starting point, reaching the most d
tant zone 27 days later.

The incidence of the disease in the various zones is fairly consta
showing only a slight tendency to decrease with increasing distar
from the primary focus. The rates are more constant than those f
individual assembly districts, as would naturally be expected, co
sidering the larger population units represented by the zones.

SPREAD TO OTHER BOROUGHS.

The Brooklyn epidemic, for reasons previously given, offer
unusual opportunities for the study of radial spread. This spre
was apparently continuous also into that part of the Borough
Queens, lying just outside the Brooklyn line. Unfortunately, t
difficulty encountered in attempting to locate accurately the cas
occurring in Queens, due to confusion in street names, prevented t
detailed extension of the zone studies into that borough.

The study of the radial spread from Brooklyn to the boroughs
Manhattan, the Bronx, and Richmond is complicated by their separ
tion from Brooklyn and from each other by considerable stretch
of deep water. Although these are spanned by numerous bridg
and traffic across them is facilitated by tunnels and ferries, the dire
geographical relationships are completely obliterated by the
Points immediately adjacent on the map are widely separated,
consideration is given to the usual routes actually taken by traffic.

In addition, it is not to be expected that with epidemic conditio
established in one borough epidemics in the other boroughs would

set up from single foci. The simultaneous foci set up, for example, in Manhattan, were widely separated, and the infection in a very short period of time was disseminated practically throughout that borough.

This is why the study of radial spread has not been continued in detail for other boroughs. For the purpose, however, of connecting the studies of epidemic spread in New York City with the studies of spread through the surrounding States, given later in this report, the cases have been tabulated by single miles from the original focus, regardless of the intervening waterways, for the first 5 miles. The next zone includes the territory lying between 5 and 10 miles from the primary focus. Beyond this point the tabulations are for 10-mile zones and are continuous throughout the infected territory in the surrounding States.

The complete table for radial spread in the city of New York, including all zones in the city itself, is given in Table G (appendix). This table may be summarized as follows:

TABLE NO. 41.—*Incidence of poliomyelitis, by zones from the epidemic focus in Brooklyn, for the city of New York, 1916.*

Zones.	Distance from focus.	Population in zone.	Number cases.	Rate per 100,000.	Date of median case.
I	Under 1 mile	198,014	479	241.9	July 5
II	1 to 2 miles	277,671	672	242.0	July 11
III	2 to 3 miles	771,636	1,517	196.7	July 22
IV	3 to 4 miles	810,532	1,549	191.4	July 28
V	4 to 5 miles	414,143	824	198.9	July 31
VI	5 to 10 miles	1,821,359	3,174	174.3	Aug. 4
VII	10 to 15 miles	733,866	739	100.8	Aug. 9

It is quite apparent, therefore, that the spread of the epidemic was markedly radial in character. The crest of the epidemic passed from within outward, requiring approximately 35 days to travel from the original focus to the outer zone of the city. The rate of incidence of the disease likewise diminished with the distance traveled from the original focus. As will be seen from later sections of this report, these characteristics were displayed by the epidemic throughout its entire course in the surrounding States. The epidemic may, therefore, be properly described as a wave, traveling from its origin outward, and diminishing in amplitude with its progress. Or, in other words, the vertical excursion of the epidemic wave progressively decreased as the horizontal excursion increased.

AGE DISTRIBUTION.

The studies of age distribution are made upon a total of 9,131 cases. Of the total 9,345 cases of record, the ages of 214 were not given. As this number is too small seriously to affect the total, an as there is no reason to suppose that they would not, in general, fo low the average age distribution of the remainder of the cases, the have been omitted from consideration in this section.

The age distribution of the 9,131 cases is given by single years Table H (appendix). This table shows the number of cases at eac age, by boroughs and for the city. In addition, Table I (appendi gives the percentage of cases in each age group under 20, and for a cases 20 years and over, by boroughs and for the city. Summariz by standard age groups, the number and percentage of cases f each age group are shown in Table No. 42.

TABLE No. 42.—*Poliomyelitis, New York City, 1916—Summary of age distrib tion of cases by standard age groups.*

[Number and percentage of cases in each age group, by boroughs, and for the city of New York.]

Age group.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		The city	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Pe cen
Under 1	351	13.5	64	9.5	469	10.8	110	8.9	20	6.8	1,014	1
Under 5	2,084	80.4	513	76.3	3,510	80.9	910	73.5	214	72.8	7,231	7
5 to 9	379	14.6	126	18.8	653	15.0	261	21.1	64	21.8	1,483	1
10 to 14	51	2.0	16	2.4	98	2.3	50	4.0	10	3.4	225	
15 to 19	27	1.0	10	1.4	29	.7	8	.6	4	1.4	78	
20 to 24	15	.6	2	.3	11	.3	3	.2	......	......	31	
25 to 34	25	1.0	4	.6	26	.6	2	.1	2	.7	59	
35 to 44	7	.3	1	.1	7	.2	2	.1	......	......	17	
45 to 64	3	.1	......	......	3	.1	1	.1	......	......	7	
All known ages	2,591	......	672	......	4,337	......	1,237	......	294	......	9,131	...

The age distribution of cases as shown by this summary is qui characteristic of urban outbreaks of poliomyelitis, and the differenc in age distribution between various boroughs are not of strikin significance. The metropolitan boroughs, Manhattan and Brookly show somewhat higher percentages of cases in the lower ages, wi correspondingly lower percentages in the higher ages, than do t suburban boroughs of the Bronx, Queens, and Richmond. In ge eral, the age distribution of the boroughs is coordinated with t total incidence, those boroughs (Queens and Richmond) with t highest rates of total incidence showing the smallest percentages cases in the lower age groups. The Bronx, however, with the lowe total incidence of any of the boroughs, occupies an intermedia position as regards age distribution.

Comparing this age distribution with that of a previous series cases as reported by Frost,[1] and adding figures for age distributio in rural districts taken from a later section of this report, we obtain the result shown in Table No. 43.

---

[1] Frost, W. H., Epidemiologic Studies of Acute Anterior Poliomyelitis, Hygienic Labo tory Bulletin No. 90, p. 209.

TABLE NO. 43.—*Incidence of poliomyelitis at various ages in recent urban and rural epidemics in the United States.*

[Percentage of cases occurring in each of the designated age groups.]

Age groups.	Urban epidemics.				Largely rural epidemics.		
	New York, 1907; 729 cases.	Cincinnati. 1911; 97 cases.	Buffalo, 1912; 274 cases.	New York, 1916; 9,131 cases.	Minnesota, 1909.	Iowa, 1910; 348 cases.	Northeast United States, 1916; 1,772 cases.
Under 1 year	8.5	17.5	8.4	11.1	6.5	4.3	6.0
1 to 5 years	82.0	75.3	73.0	74.7	48.6	48.3	59.3
6 to 10 years	6.4	6.2	13.9	10.5	23.7	21.4	20.0
11 to 15 years	1.9	1.0	1.2	1.9	7.7	10.7	6.4
16 to 20 years	.7	....	2.2	.6	6.5	7.5	3.1
Adults	.4	....	.7	1.2	7.0	7.5	5.2
Total under 6	90.5	92.8	81.4	85.8	55.1	52.6	65.3
Total under 16	98.8	100.0	97.1	96.3	86.5	84.7	91.7

The age distribution of the cases in the outbreak of 1916, therefore, is in general quite similar to that observed in previous outbreaks of the disease in urban communities. It is, on the other hand, quite different from that observed in previous rural outbreaks and from the rural cases of 1916.

The very great predominance of cases in the younger age groups, particularly in the ages under 5, is one of the most constant and striking of the epidemiologic phenomena exhibited by poliomyelitis. The variations in the age distribution of urban and rural outbreaks is likewise of interest in connection with the problem of the source of the apparent immunity of persons in the higher age groups.

In this connection Frost's discussion upon this point in the work cited may be of interest. After pointing out the difference in age incidence as observed in urban and rural outbreaks of the disease and regretting the paucity of data, he says:

> The differences noted in the age distribution of poliomyelitis cases in metropolitan and rural communities, if they prove to be constant, would appear to have a rather definite epidemiological significance which can at present, in view of the paucity of data available, be merely suggested as a possibility, not accepted as a conclusion.
>
> A constantly greater immunity of adults and adolescents in metropolitan than in rural communities would suggest as a possible, perhaps the most probable, explanation that the metropolitan populations had previously acquired a greater degree of immunity. Measles may be cited as a well-known example of a disease whose incidence is confined almost exclusively to children in those countries where it is endemic. This is apparently due, in large part if not wholly, to the facts that one attack confers a definite and lasting immunity and that few escape infection in their childhood. In remote communities, where

the infection has not prevailed for one or more generations, measles when introduced attacks adults as well as children, thus demonstrating that adult ag does not of itself confer immunity. Yellow fever affords another simila example. When introduced into a community that has long been free fron the infection it attacks persons of all ages. In endemic foci its incidence i apparently almost confined exclusively to newcomers and (presumably at least to children, although in the latter the attacks are apparently often, if not usually, unrecognized.

To even suggest a general immunization of a large population agains poliomyelitis, a disease considered quite rare, may seem unjustifiably radical yet Wernstedt[1] has not hesitated to conclude from the results of epidemiological and experimental studies in Sweden that such is actually the case.

ATTACK RATES AT DIFFERENT AGES.

It is quite evident that the very great excess of cases in the lower age groups is not dependent upon distribution of population alone In order to show the differences in the attack rates at different ages the attack rates per 100,000 living at each age have been computed

As the New York State census, used as the basis for all computations of rates in this report, gives no tables of age distribution, the number of persons living at each age was estimated from the total population, as given by the State census, using the percentage distribution of population given by the United States census of 1910.

The estimates for the number of persons living at each age for the city as a whole were obtained by using the sum of the persons at each age as estimated for the various boroughs. The difference between the estimates so derived and those derived from the assumption that the distribution for the entire city had not changed is not sufficient to modify significantly the rates for the different age groups. These estimates, while based on assumptions that may not be exactly in accord with the facts, do not in all probability vary sufficiently from the real facts to affect significantly the figures for incidence at different ages.

The estimated number of persons living at each age in the various boroughs, with the number of cases occurring at that age, and the number of cases per 100,000, are given in Table J (appendix). The attack rates at the various ages for the city as a whole are summarized in the following table:

---

[1] Investigations on Epidemic Infantile Paralysis, Report from the State Medical Institute of Sweden to the Fifteenth International Congress on Hygiene and Demography Washington, D. C., 1912, pp. 235–267.

TABLE No. 44.—*Attack rates at different ages, New York City.*

Age group in years.	Estimated persons living at that age.	Cases at that age.	Cases per 100,000 persons.
Under 1	117,000	1,014	867
1 to 4	422,900	6,217	1,469
Total under 5	539,900	7,231	1,339
5 to 9	469,800	1,483	316
10 to 14	452,600	225	49.7
15 to 19	484,200	78	16.1
20 to 24	556,300	31	5.6
25 to 34	969,000	59	6.1
35 to 44	731,400	17	2.3
45 to 64	693,000	7	1.0
65 and over	145,000	0	0.0

This table and the accompanying chart (chart No. 10) illustrate most strikingly the highly selective incidence of the disease. In the ages between 1 and 4 approximately 1 in 70 of children were attacked,

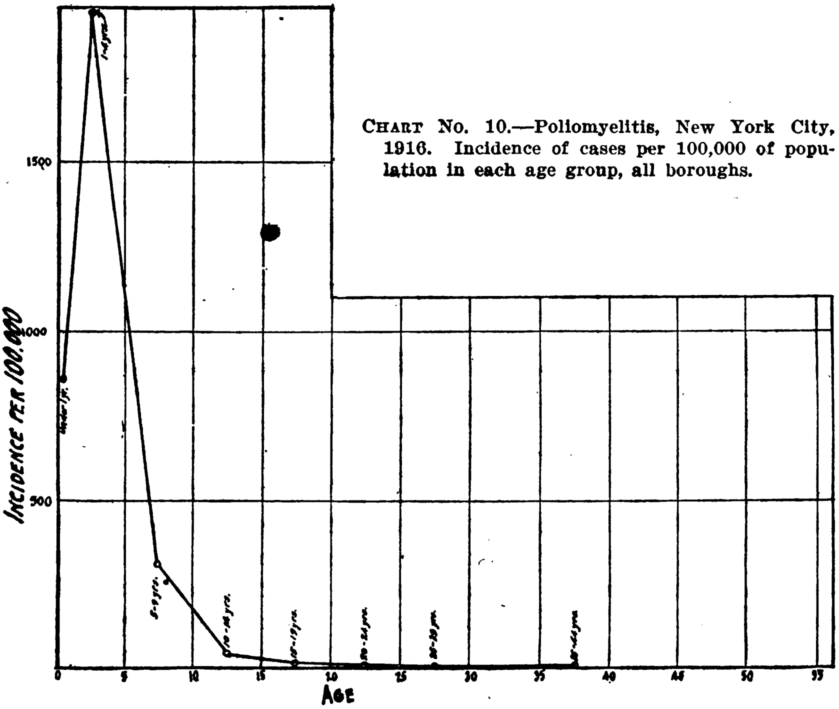


CHART No. 10.—Poliomyelitis, New York City, 1916. Incidence of cases per 100,000 of population in each age group, all boroughs.

while for the ages between 45 and 64 only 1 person in 100,000 was attacked. The very sharp decline in the rate after five years of age, reaching practically to zero in the ages above 45, is of the greatest interest.

The differences in incidence of poliomyelitis at the different ag for the various boroughs, while striking, are not significantly di ferent from those shown in the calculations of percentage distr bution.

VARIATIONS IN AGE DISTRIBUTION DURING COURSE OF THE EPIDEMIC.[1]

The very large number of cases included in the series under di cussion permits of forms of analysis not possible with smaller nun bers. During the course of the epidemic current studies made at th time disclosed the fact that with the advance of the epidemic i Brooklyn there had occurred a change in the age distribution of th cases. For better study of this phenomenon the cases were tabulate by days according to age groups, for Manhattan and Brooklyı The necessary limitations of space renders it impracticable to publis these tables in full, and there is presented in Table K (appendix) summary of the results of this method of tabulation. For this pu pose the cases have been divided into successive groups of approx mately 500 cases each, in the order of their onsets, and the age distr bution of the successive groups ascertained. Such tabulations wer made for Manhattan and Brooklyn only, since the number of case occurring in the other boroughs was not sufficiently large to mak groups of such size as to exclude the effect of the statistical irreg

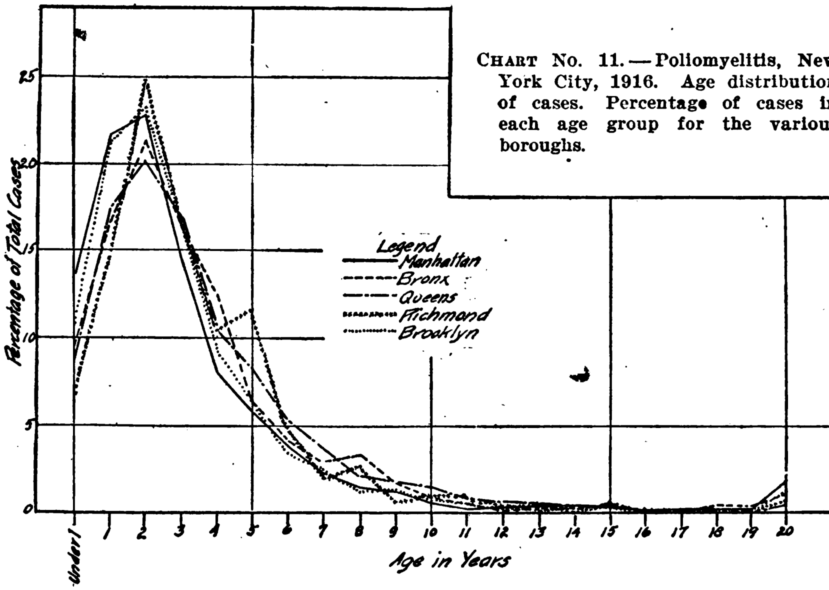


CHART No. 11.—Poliomyelitis, Nev York City, 1916. Age distributio of cases. Percentage of cases i each age group for the variou boroughs.

---

[1] See chart No. 11.

larity incident to small groups. A group of 500 cases is believed to be of sufficient size to exclude gross statistical irregularity.

While the tables show interesting and perhaps significant changes in the percentage of cases at various ages with the course of the epidemic, these changes are best shown by an examination of the percentage of cases 6 years of age and over. The percentage 6 years and over of the cases in the successive groups, with the dates covered by the groups, are, for Brooklyn, as follows:

TABLE No. 45.—*Brooklyn—Percentage of cases 6 years and over.*

Percentage of cases 6 years and over:

Period 1.	May 8–June 27	6.0
2.	June 27–July 5	10.0
3.	July 6–July 12	12.9
4.	July 13–July 19	13.7
5.	July 20–July 25	13.0
6.	July 26–July 31	10.7
7.	Aug. 1–Aug. 6	12.5
8.	Aug. 7–Aug. 18	16.1
9.	Aug. 19–Oct. 30	20.2

The percentage of cases 6 years and over, for the successive groups in Manhattan, are as follows:

TABLE No. 46.—*Manhattan—Percentage of cases 6 years and over.*

Percentage of cases 6 years and over:

Period 1.	May 6–July 22	8.8
2.	July 23–Aug. 2	12.3
3.	Aug. 3–Aug. 13	15.1
4.	Aug. 14–Aug. 26	17.2
5.	Aug. 27–Oct. 30	15.6

As is very clearly shown by the above tables, the percentage of cases in persons 6 years and over showed a very marked tendency to increase with the progress of the epidemic. It is of interest to note that in Brooklyn the periods of decrease in percentage of cases 6 years and over (periods 5 and 6) correspond quite accurately to the time when the epidemic, after reaching its apparent crest, again took an upward turn, the number of cases increasing rapidly until the true crest was reached. It would appear, therefore, that there was in this epidemic a stage marked by a very low percentage of cases in persons 6 years and over, which may be termed the stage of invasion, and that the percentage of cases in the age groups 6 years and over increased gradually, except where the progress of the epidemic was temporarily halted. The stage of invasion again appeared, the percentage in the higher ages again increasing with the progress of the new rise.

In general it may be said, therefore, that the age distribution the cases in this epidemic was quite characteristic of urban epidemi of the disease, and that the highly selective age incidence of t disease was strikingly demonstrated.

The age distribution of the cases, however, exhibited certain ve interesting and perhaps significant variations during the course the epidemic, which if proved constant for other epidemics may ha an important bearing on the causes underlying epidemic spread.

SEX DISTRIBUTION OF CASES.

The sex distribution of the cases of poliomyelitis occurring in t epidemic in New York City in 1916 was quite characteristic of t disease as reported in previous epidemics. Of the 9,345 cases liste 5,106 were males, 3,909 females, and the sex of 330 was not give The ratio of males to females was 1.31 to 1.

Previous epidemics have shown the same striking disproportion males. Frost, in the work cited, has collected a number of repor of epidemics, which may be summarized as follows:

TABLE NO. 47.—*Sex distribution of cases of poliomyelitis in various epidemi*

Epidemic.	Total cases.	Males.	Females.	Ratio males t females:
Massachusetts, 1909	626	363	263	1
Minnesota, 1909	332	193	139	1
Iowa, 1910	345	200	145	1
New York State, 1910	227	118	109	1
District of Columbia, 1910	246	151	95	1
Cincinnati, 1910	150	91	59	1
Buffalo, 1912	274	161	113	1
All cases	2,200	1,277	923	1

The marked excess of males over females in the persons attack is one of the most constant of the epidemiologic characteristics of t disease. It may depend, of course, either upon unequal exposure the infection on the part of the two sexes or upon differences in degr of resistance to the virus if the two sexes are equally exposed. the difference in the attack rates of the two sexes is due to differenc in exposure to the infection, dependent upon the differences in t habits of the two sexes, this difference would naturally be expected appear at those ages at which the differences in habit between t two sexes is most marked. These differences in habit are evident least in infancy and greatest in adult life.

An examination of the sex distribution of the cases, however, given in Table L (appendix), shows that the difference is qui marked in the years under 2, well marked in all ages under 5, befo any definite differences in habit are manifest, and continues somewh irregularly at all ages. The numbers of cases in the older age groups are so small as to make the ratios in these age groups somewhat untrustworthy. The sex differences by age groups are shown in the following summary:

TABLE No. 48.—*Sex distribution of poliomyelitis at different ages, New York City, 1916.*

Age group.	Total cases.	Males.	Females.	Ratio males to females: 1.
Under 1 year	1,001	557	444	1.25
Under 5	7,148	4,069	3,079	1.31
5 to 9	1,455	809	646	1.25
10 to 14	222	119	103	1.16
15 to 19	77	40	37	1.08
20 years and over	113	69	44	1.57
All ages	9,015	5,106	3,909	1.31

As will be seen from the tables, the excess of males in persons attacked is common at all ages. There is no reason, therefore, to believe that this difference in the attack rate of the two sexes is dependent upon any differences in habit or exposure.

For comparison with the sex incidence of poliomyelitis, the variations in sex incidence of various other diseases have been studied as far as the available meager material bearing on the subject will permit. For this purpose there are available the statistics of sex distribution of typhoid fever, scarlet fever, and diphtheria from the reports of the Pennsylvania State Department of Health; the statistics on measles, chickenpox, mumps, whooping cough, and cerebrospinal meningitis from the annual reports of the bureau of health of Philadelphia, Pa.; and certain statistics of cerebrospinal meningitis collected by Sophian from the epidemic of 1912 in the southwestern part of the United States. These reports are presented herewith.

TABLE No. 49.—*Sex distribution of measles, Kansas State, 1914–15.*

Year.	Cases.	Males.	Females.	Ratio males to females : 1.
1914	5,310	2,194	2,116	1.03
1915	7,255	3,592	3,663	.98
Total	12,565	5,786	5,779	1.00

In view of the marked excess of males over females in Kansas, as shown by the 1910 census, 110 males to 100 females, these figures should be corrected to conform to the difference. Computing the figures to rates on the basis of the sex populations for 1910, we find the rates to be, males 326.6 per 100,000; females 358.9 per 100,000.

The true ratio of attack rates between the two sexes in Kansa therefore, is males 0.91 to females 1.

TABLE NO. 50.—*Sex distribution of measles, Philadelphia, 1912–1916.*

Year.	Total cases.	Males.	Females.	Ratio males to females:
1912	2,279	1,148	1,131	1.
1913	15,611	7,611	8,000	.
1914	7,096	3,567	3,529	1.
1915	14,089	7,244	6,845	1.
1916	8,792	4,611	4,181	1.
Total	46,867	24,181	23,686	1.

The population of Philadelphia shows a marked excess of female 760,463 males to 788,545 females, for 1910. The cases have been r duced to rates for the two sexes, with the following result: Male 636 per 100,000; females, 600.8 per 100,000. The true ratio is, ther fore, 1.06 males to 1 female.

For typhoid fever, diphtheria, and scarlet fever, Table M (appe dix) shows the number of cases of these diseases, divided according sex, occurring in the State of Pennsylvania between the years 190 and 1912, inclusive, with ratios, annual averages, annual averag rates, and average ratios.

From this table it will be seen that in typhoid fever the males a constantly in excess, the ratio sometimes going as high as 1.4 to The ratio for the entire period, corrected for differences in sex di tribution of the population, is 1.29 males to 1 female.

In diphtheria, on the contrary, the females are constantly in exces the ratios of males to females varying from 0.87:1 to 0.93:1. T ratio of the average rates is 0.86 male to 1 female.

In scarlet fever, likewise, the females are constantly in excess, th ratio of males to females ranging from 0.87:1 to 0.91:1. The rat of the average rates is 0.84 male to 1 female.

For cerebrospinal meningitis two small series of cases are availabl as follows:

TABLE NO. 51.—*Sex distribution of cases of cerebrospinal meningitis, epidem of 1912 (Sophian).*[1]

SOUTHWESTERN UNITED STATES.

	City cases.	County cases.	Total cases.
Males	829	519	1,3
Females	479	308	7
Total	1,308	827	2,1

Ratio males to females, 1.71 : 1.

---

[1] Sophian, A. Epidemic Cerebrospinal Meningitis, 1913.

TABLE No. 51.—*Sex distribution of cases of cerebrospinal meningitis, epidemic of 1912 (Sophian)*—Continued.

PHILADELPHIA, 1910-1912.

Year.	Cases.	Males.	Females.
1910	33	22	11
1911	29	20	9
1912	37	18	19
Total	99	60	39

Ratio males to females, 1.54 : 1.

For chicken pox, mumps, and whooping cough there are available a series of cases from the reports of the bureau of health of the city of Philadelphia, for the years 1910–1912, inclusive, as follows:

TABLE No. 52.—*Sex distribution, series of cases in Philadelphia, 1910–1912.*

Year.	Mumps.			Chicken pox.			Whooping cough.		
	Cases.	Males.	Females.	Cases.	Males.	Females.	Cases.	Males.	Females.
1910	819	450	369	1,821	983	838	1,410	759	651
1911	2,147	1,041	1,106	3,377	1,787	1,590	1,369	675	694
1912	601	312	289	1,515	869	646	1,845	1,027	818
Total	3,567	1,803	1,764	6,713	3,639	3,074	4,624	2,461	2,163

Ratio of males to females: Mumps, 1.02:1; chicken pox, 1.18:1; whooping cough, 1.09:1.

From the tables it will be seen that males are somewhat more liable to attack in a majority of the common communicable diseases. In diphtheria and scarlet fever females are somewhat more liable to attack. In measles the differences between the sexes are neither constant nor striking. The marked excess of males in typhoid fever, poliomyelitis, and cerebrospinal meningitis is the most striking phenomenon in connection with sex distribution.

In connection with the correction of certain rates for differences in sex distribution it should be stated that the sex distribution of the population of New York City is so nearly equal between the two sexes that correction is not necessary.

A summary of the sex distribution of the cases of poliomyelitis comprised in the epidemic of 1916 confirms the observations of previous reporters as to the marked excess of males in the persons attacked. This excess of males is common at all ages and can not, therefore, depend upon any differences in habit or exposure of the two sexes. Other communicable diseases show tendencies to attack one or the other of the two sexes in excess, but only in typhoid fever and cerebrospinal meningitis is the disproportion as striking and constant as in poliomyelitis.

FATALITY OF THE EPIDEMIC.

The data regarding the fatality of poliomyelitis during the ep demic in New York City were furnished by the director of t bureau of records of the department of health. As the investigati was started sometime after the epidemic began, the first series records furnished covered all deaths which had occurred up to th time. Subsequently all records of fatal cases were furnished dai The records furnished were either in the form of photographic repr ductions of the original certificate of death or an abstract of t certificate, giving the information desired for statistical purposes.

These reports were compared with the files of reported cases a the effort made to identify all fatal cases with cases previously r ported. In many cases this was impossible, since the case had fi been reported as a death, and no epidemiologic card was made o by the health department's inspector. In such cases, a case card w then made out, based on the information given by the death certi cate, and the individual carried as a case as well as a death. I some cases the information on the death certificate was not sufficie to furnish the basis of a case card, and for this reason a few fat cases are not carried as cases, except in the group of defective cas not included in any of the tabulations. The number of such cas however, is small, and not sufficient to affect significantly any co clusions drawn from the statistical studies.

All deaths were tabulated and studied as of the date of onset the disease, and no tabulations are based on the dates of death. I this method the fictitiously high death rates of the later stages the epidemic, caused by the deaths during that period of perso who had suffered from the disease early in the epidemic, are in pa avoided. There is apparently, however, still an element of error the fatality rates for the last weeks of the epidemic. The reports deaths were received at that time much earlier than the case car Several deaths were registered, therefore, for which case cards we not received prior to the closing of the work on November 1. The death certificates did not contain sufficient information to form t basis of a case card. Consequently they were carried as deaths, b not in every case as cases.

CASE FATALITY BY WEEKS.

The number of cases occurring each week during the course of t epidemic, the number of these terminating fatally, and the percen age case fatality is given in Table N (appendix).

As will be seen from this table the percentage fatality show marked variations from week to week, these variations being som what irregular. After the relatively high fatality of the first wee the succeeding weeks showed low but gradually increasing percen ages until the eighth week, then remaining high with considerable variations until the nineteenth week when another period of low rates, lasting four weeks, occurred. This was followed by another period of high percentages, lasting until the end of the epidemic, and due in part, as has been said, to incomplete case reports. In the early and late stages of the epidemic the numbers of cases and deaths are so small as to be subject to considerable variations from statistical irregularity alone.

The case fatality for the entire epidemic is 24 per cent. This fatality may be compared with that of previous epidemics of the disease as follows:

TABLE No. 53.—*Case fatality of epidemics of poliomyelitis.*

Years.	Place.	Cases.	Deaths.	Case fatality.
				Per cent.
1910	Iowa State	345	68	19.7
1911	Cincinnati, Ohio	150	46	30.7
1912	New York State	1,108	183	16.5
1913	New York City	504	57	11.3
1914	do	129	34	26.4
1915	do	95	15	15.8
1910	Massachusetts	845	122	14.4
1911	do	260	55	19.2
1912	do	169	50	29.6
1913	do	362	67	18.5
1904–1913	Norway (Leegaard)	....	....	17.1
1908–9	Austria (Zappert, Leiner, and Weisner)	555	61	11.0
1905	Southern Sweden (Wickman)	1,031	145	14.1

FATALITY BY SEX AND AGE.

In Table O (appendix) is shown the number of fatal cases for each age below 20, and for standard age periods above that age, by sexes and for both sexes, by boroughs, and for the city. Table P (appendix) gives the percentage fatality for the city as a whole by years under 20, and standard age periods above that age, by ages and for both sexes.

The percentage case fatality for the standard age periods is as follows:

TABLE No. 54.—*Case fatality by standard age periods.*

Age periods.	Cases.	Deaths.	Fatality.
			Per cent.
Under 1	1,014	358	35.3
Under 5	7,231	1,713	23.7
5 to 9	1,483	379	25.6
10 to 14	225	63	25.6
15 to 19	78	24	32.5
20 to 24	31	13	41.9
25 to 29	42	13	31.0
30 to 34	17	6	35.3
35 to 39	12	5	41.7
40 to 44	5	2	40.0
45 and over	7	....	....
Unknown	214	25	....
All ages	9,345	2,243	24.0

As will be seen from this table, the case fatality is higher under year, lower in the group under 5, and then progressively higher age advances. The number of cases and deaths in the higher a groups, however, is too small to give reliable and consistent resul By reference to the table for single years, it will be seen that the re point of lowest fatality is at 2 years of age, which is also the a of highest case incidence.

For comparative purposes, the case fatality of three of the cor moner communicable diseases—measles, diphtheria, and scarl fever—have been computed by corresponding age periods and a given in Table No. 55. (The figures for measles in this table we obtained from the report of the Kansas State Board of Health.[1])

TABLE No. 55.—*Case fatality at different ages of the common communicab diseases.*

Age groups.	Measles, Kansas, 1914-15.			Scarlet fever, Pennsylvani 1907-1912.		
	Cases.	Deaths.	Fatality.	Cases.	Deaths.	Fatalit
			Per cent.			*Per cen*
0 to 5	2,295	95	4.1	20,024	3,309	1
5 to 9	4,309	9	.2	29,949	1,484	
10 to 14	2,805	9	.3	16,905	468	
20 to 29	693	6	.9	2,872	156	
30 to 39	202	6	3.0	796	44	
40 to 49	82	4	4.9	201	10	
50 to 59	20	4	20.0	51	6	1
60 to 69	4	2	50.0	10	4	4
70 and over	3	1	33.3	8	4	5
Unknown	1,152	....	....	....	....	....
Total	11,565	136	1.2	70,816	5,485	

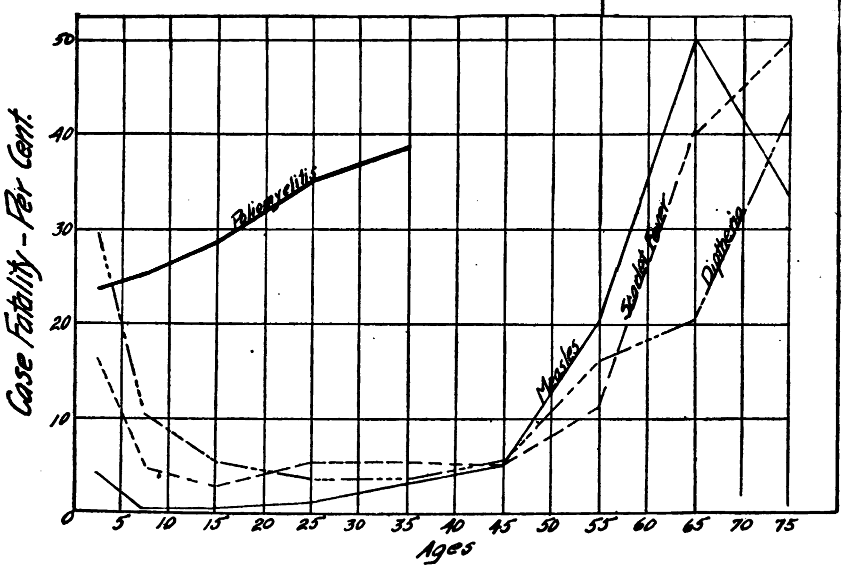
Age groups.	Diphtheria, Pennsylvania, 1907-1912.			Poliomyelitis, New York, 191		
	Cases.	Deaths.	Fatality.	Cases.	Deaths.	Fatalit
			Per cent.			*Per cen*
0 to 5	27,821	8,157	29.3	7,231	1,713	2
5 to 9	29,900	3,117	10.4	1,483	379	2
10 to 14	15,431	828	5.4	303	87	2
20 to 29	4,817	180	3.7	73	26	3
30 to 39	2,433	88	3.6	29	11	3
40 to 49	815	45	5.5	11	2	1
50 to 59	290	47	16.2	1	0	
60 to 69	81	17	21.0	....	....	....
70 and over	38	16	42.1	....	....	....
Unknown	....	....	....	214	25	....
Total	81,626	12,495	15.3	9,345	2,243	2

The result of this tabulation is shown graphically by the accon panying chart (chart No. 12), which illustrates the percentag fatality for the different diseases for the various age groups. It to be regretted that the statistical information for scarlet fever an diphtheria is not sufficiently in detail to permit the tabulation of these diseases by single years under ten, since the five-year grouping obscures the true low point in several of the curves. As will be seen from the chart, the curves for measles, scarlet fever, and diphtheria are strikingly similar in their general outlines, the fatality rate being higher in the ages under 5, tending strongly downward during the years of adolescence, and upward again with adult and middle life. Poliomyelitis departs markedly from the other diseases in the general shape of its curve, showing its lowest rate for the group under five and tending strongly upward for all higher age groups. Like measles, however, its lowest fatality is in the age group of highest incidence.

---

[1] Bulletin of the Kansas State Board of Health, May, 1916, Vol. XII, p. 345, seq.

Chart No. 12.—Poliomyelitis, New York City, 1916. Case fatality: Deaths per 100 reported cases in each age group, with measles, scarlet fever, and diphtheria for comparison.



VARIATIONS IN CASE FATALITY BY BOROUGHS.

The case fatality by boroughs has been computed and is given in Table No. 56.

TABLE NO. 56.—*Poliomyelitis, New York City, 1916—Case fatality by boroughs, cases, deaths, and per cent fatality for each age group.*

Age group.	Manhattan.			Bronx.			Brooklyn.		
	Cases.	Deaths.	Per cent.	Cases.	Deaths.	Per cent.	Cases.	Deaths.	Per cent.
Under 1	351	132	37.6	64	20	31.2	469	160	34.1
Under 5	2,084	495	23.8	513	101	19.7	3,510	857	24.4
5 to 9	379	101	26.7	126	31	24.6	653	173	26.5
10 to 19	78	26	33.3	26	9	34.6	127	33	26.0
20 to 29	33	14	42.4	5	2	40.0	29	7	24.1
30 to 39	12	5	41.7	2	0	0	12	5	41.7
40 to 49	5	1	20.0	0	0	0	5	1	20.0
50 to 59	0	0	....	0	0	....	1	0	0
60 to 69	....	....	....	....	....	....	....	....	....
70 and over	....	....	....	....	....	....	....	....	....
Unknown	81	14	....	18	1	....	87	1	....
Totals and averages	2,672	656	24.6	690	144	20.9	4,424	1,077	24.3

Age group.	Queens.			Richmond.			The city.		
	Cases.	Deaths.	Per cent.	Cases.	Deaths.	Per cent.	Cases.	Deaths.	Per cent.
Under 1	110	40	36.4	20	6	30.0	1,014	358	35.3
Under 5	910	220	24.2	214	40	18.7	7,231	1,713	23.7
5 to 9	261	62	23.8	64	12	18.8	1,483	379	25.6
10 to 19	58	17	29.3	14	2	14.3	303	87	28.7
20 to 29	5	2	40.0	1	1	100.0	73	26	35.6
30 to 39	2	0	0	1	1	100.0	29	11	38.0
40 to 49	1	0	0	0	0	....	11	2	18.2
50 to 59	0	0	0	0	0	....	1	0	0
60 to 69	....	....	....	....	....	....	....	....	....
70 and over	....	....	....	....	....	....	....	....	....
Unknown	26	9	....	2	....	....	214	25	....
Totals and averages	1,263	310	24.5	296	56	18.9	9,345	2,243	24.0

The variations in fatality at the various ages are seen to be irregular and without apparent significance. The groups are in many cases too small for regularity.

COMPARATIVE FATALITY, MALES AND FEMALES.

The table of fatality by sexes (Table P, appendix) shows some variations of interest and perhaps of significance. The fatality for males is higher than for females, 25.6 as against 23.2 per cent. Males show higher percentages in the ages under 6, while females show higher fatality between 6 and 20. Beyond 20 the groups are too small for significance. (Chart No. 13.)

SUMMARY.

The studies of fatality do not show any very striking characteristics, with the exception that the case fatality was in general higher than the average for large outbreaks notwithstanding the fact that in all probability the reporting of cases in this epidemic was more complete than in most of the epidemics which have furnished the statistics used for comparison. The fatality rate showed certain interesting variations during the course of the epidemic. It is lowest in age groups 1 to 5, and highest at the older ages, the difference not being very striking until after the age of 15. The curve of case fatality differs rather strikingly from that of measles, scarlet fever, and diphtheria. The fatality, as well as the rate of incidence, is higher for males than for females.

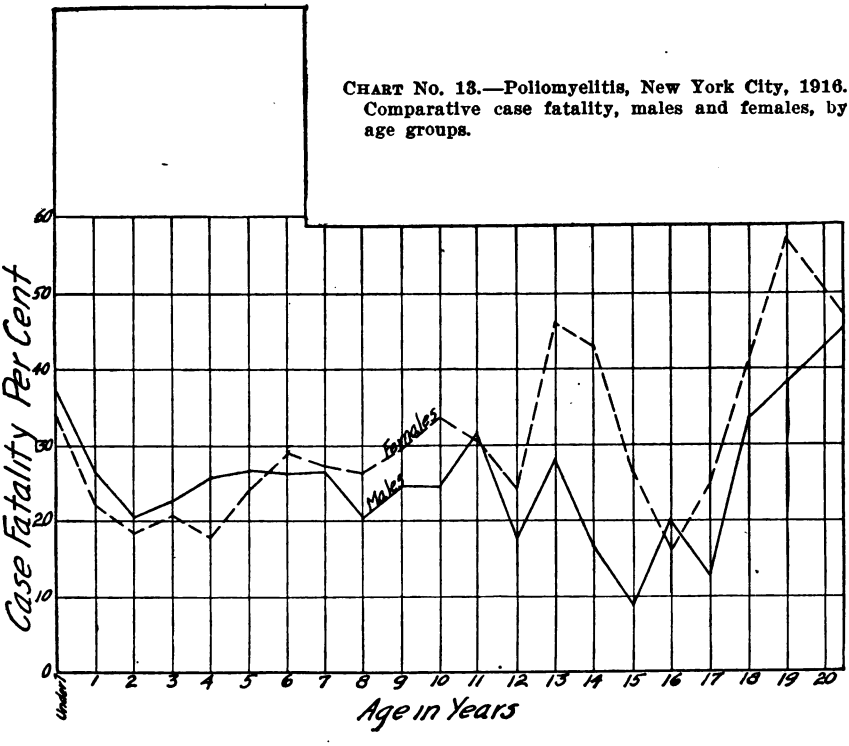


CHART No. 13.—Poliomyelitis, New York City, 1916. Comparative case fatality, males and females, by age groups.

OCCURRENCE OF MULTIPLE CASES IN THE SAME FAMILY.

In the epidemiologic study of infectious diseases the occurrence of multiple cases in the same family has long been considered of importance in estimating the infectiousness of the disease. Chapin[1] has for a number of years made interesting and important observations by this method in connection with scarlet fever and diphtheria in Providence, R. I., and Frost[2] and Hill[3] have employed the same method in poliomyelitis. The large number of cases in the New York series, including as it does a considerable number of multiple cases in families, offers unusual opportunities for studies of this kind.

---

[1] Chapin, C. V., Annual Reports, Supt. Health, City of Providence, R. I.

[2] Frost, W. H., Hygienic Laboratory Bulletin No. 90.

[3] Hill, H. W., Epidemiologic Study of Anterior Poliomyelitis in Minnesota, Trans. Sec. Prev. Med. and Public Health, Amer. Med. Assn., June, 1910.

There are available for these studies 9,116 cases. Of the cases of record, 229 have been omitted from consideration, having been reported from hospitals as deaths or having occurred under circumstances where family exposure either did not exist or was not reported upon. These 9,116 cases occurred in 8,709 families, as follows:

TABLE No. 57.—*Multiple cases in families.*

		Total cases.
Families with 1 case	8,331	8,331
Families with 2 cases	353	706
Families with 3 cases	21	63
Families with 4 cases	4	16
Total	8,709	9,116

These multiple cases were distributed among the various boroughs as follows:

TABLE No. 58.—*Multiple cases by boroughs.*

Boroughs.	Number of families with—				Total families.	Percentage with more than 1 case.
	1 case.	2 cases.	3 cases.	4 cases.		
Manhattan	2,502	63	2	0	2,567	2.5
Bronx	609	23	1	0	633	3.8
Brooklyn	3,863	188	15	3	4,069	5.1
Queens	1,108	68	2	0	1,178	5.9
Richmond	249	11	1	1	262	5.0
Total	8,331	353	21	4	8,709	4.3

It will be seen from the table that the percentage of families showing multiple cases in the various boroughs varied somewhat in proportion to the total incidence in the population. Manhattan and the Bronx with lowest total incidence had the lowest percentage of families with multiple cases, while the three other boroughs, with total incidence much higher than that of Manhattan and the Bronx, had also the larger percentage of families with multiple cases.

ATTACK RATES.

The total number of persons living in the 8,709 families in which cases of poliomyelitis occurred, have been tabulated according to age, and the percentage of persons of each age who developed the disease, commonly called the "attack rate," has been computed. These figures are given in Table No. 59, while in Table No. 60 are given similar figures for scarlet fever and diphtheria as computed by Chapin.

BLE No. 59.—*Poliomyelitis, New York City, 1916—Attack rates, initial and subsequent, in 8,709 families.*

Ages.	Number in families, including cases.	Initial cases.	Initial attack rate.	Number in families, primary cases excluded.	Subsequent cases.	Subsequent attack rate.
			Per cent.			
5 years	17,927	7,387	41.2	10,540	335	3.18
10	5,449	874	16.1	4,575	58	1.27
o 20	5,202	208	4.0	4,994	10	.2
ults over 20	17,294	103	.6	17,191	4	.02
known ages	137	137				
Total	46,009	8,709	18.9	37,300	407	1.1

BLE No. 60.—*Attack rates, initial and subsequent, in which the patient lived and remained at home.*

SCARLET FEVER, PROVIDENCE, R. I., 1904-1909.

Age.	Susceptible persons in families, including cases.	Initial cases.	Initial attack rate.	Exposed in families, primary cases excluded.	Subsequent cases.	Subsequent attack rate.
5 years	2,228	735	33.0	1,493	360	24.1
10	1,925	837	43.4	1,088	279	25.7
to 20	1,765	361	20.2	1,404	136	9.7
er 20	4,469	130	2.9	4,339	52	1.2
Total	10,387	2,063	19.9	8,324	827	9.9

DIPHTHERIA, PROVIDENCE, R. I., 1904-1913.

tack rates, initial and subsequent, in 3,078 families, where patient lived and remained at home. Well persons removing from the infected family omitted from tabulation of those exposed.]

Age.	Total in family, in-including cases.	Initial cases.	Initial attack rate.	Exposed in families, initial cases and those who went away excluded.	Subsequent cases.	Subsequent attack rate.
5 years	3,155	1,127	35.7	2,006	295	14.9
10	2,569	1,136	44.2	1,410	219	15.5
to 20	2,701	518	19.2	2,137	148	6.9
er 20	7,845	297	3.8	7,529	136	1.8
Total	16,270	3,078	18.9	13,082	798	6.1

These tables may be summarized as follows:

BLE No. 61.—*Attack rates, primary and secondary, poliomyelitis, scarlet fever, and diphtheria.*

[Percentages.]

Age.	Poliomyelitis.		Scarlet fever.		Diphtheria.	
	Primary.	Secondary.	Primary.	Secondary.	Primary.	Secondary.
5 years	41.2	3.2	33.0	24.1	35.7	14.9
10	16.1	1.3	43.4	25.7	44.2	15.5
to 20	4.0	.2	20.2	9.7	19.2	6.9
er 20	.6	.02	2.9	1.2	3.8	1.8
l ages	18.9	1.1	19.9	9.9	18.9	6.1

The percentage of persons attacked at all ages, as shown by the table, is, for primary cases, almost the same. This is to be expected since, considering only one case in each family, the percentage attacked varies only with the average size of the family. The primary attack rates, in general, reflect only the selective-age incidence of the disease. The secondary attack rates, however, would seem to indicate quite striking differences in the liability of persons exposed in the family with a case of the disease to contract it. In poliomyelitis only 1 person in 100 exposed in the family with a case develops it, while in scarlet fever 1 in 10, and in diphtheria 1 in 16, of those so exposed develops the disease. This difference in the apparent contagiousness of the diseases is seen at all ages. It is more marked, however, at the higher ages. This is, of course, in part explained by the fact that only frank cases of poliomyelitis are included in the tabulation, although abortive and unrecognizable forms of the disease are apparently present in such families with frequency.

In addition, the incidence of the disease in those exposed to infection from a previous case in the same family has been compared with the incidence in those of comparable ages in the general population. Similar compilations have been made for scarlet fever and diphtheria, based upon the invaluable studies of these diseases made by Chapin and published in his annual reports as superintendent of health for Providence, R. I. The basis for this comparison is given in Table No. 62.

TABLE NO. 62.—*Poliomyelitis, New York City, 1916—Incidence in the general population as compared with incidence in persons in family with a case of poliomyelitis.*

Ages.	General population.			Persons in family with case.		
	Population at each age (estimated).[1]	Cases in each group.	Incidence per 10,000.	Persons exposed, initial cases excluded.	Subsequent cases.	Incidence per 10,000.
0 to 5	629,710	7,838	124.5	10,540	335	318
6 to 10	460,700	956	20.8	4,575	58	127
11 to 20	995,020	228	2.3	4,994	10	20
Over 20	3,001,902	109	.4	17,191	4	2
Age unknown		214				
Total	5,087,332	9,345	18.4	37,300	407	109

[1] Population at various ages estimated from 1915 State census; on age distribution from United States census, 1910.

The table for poliomyelitis is based on the occurrence of secondary cases, including simultaneous cases, during the course of the epidemic, as compared with the incidence in the general population of New York City during the same period, using estimates of age disribution based on the population for 1915 and the age distribution of the 1910 census.

The table for scarlet fever follows:

TABLE No. 63.—*Scarlet fever, Providence, R. I.—Comparative incidence in the general population (1909–1911) and in susceptible individuals in the family with a case of scarlet fever (1904–1909).*

Ages.	General population.			Susceptible cases in family with a case which lived and remained at home.		
	Population at each age (estimated).	Annual average number of cases, 1909–1911.	Average incidence per 10,000.	Persons exposed, initial cases excluded.	Subsequent cases.	Incidence per 10,000.
0 to 5	25,555	238	93.1	1,493	360	2,410
6 to 10	18,627	215	115.4	1,088	279	2,570
1 to 20	39,195	97	24.8	1,404	136	970
Over 20	140,949	45	3.2	4,337	52	120
All ages	224,326	595	26.5	8,324	827	990

The preceding table is based on the annual average prevalence of that disease in Providence for the three years 1909–1911, inclusive, computed to rates from the age distribution of the 1910 census. The number of secondary cases for the three years is so small as to be unreliable for statistical purposes, and for this reason the average incidence of secondary cases in those exposed, for the period 1904–1909, is used. As this secondary attack rate has been remarkably constant during the period covered by Chapin's statistics, it is not believed that any considerable error will result from the assumption that the rate of secondary attack for 1909–1911 was the same as that for the period 1904–1909.

Similarly, for diphtheria the incidence in the general population is computed from the average annual rates for 1909–1911, and the secondary attack rates from the average rates for 1904–1913.

TABLE No. 64.—*Diphtheria, Providence, R. I.—Comparative incidence in the general population, 1909–1911, and in persons exposed in family with a case which lived and remained at home (1904–1913).*

[Well persons removing from the infected family omitted from tabulations of those exposed.]

Ages.	Population at each age (estimated).	Annual average number of cases.	Average incidence per 10,000.	Number exposed, initial cases excluded.	Number of subsequent cases.	Incidence per 10,000.
0 to 5	25,555	284	111.1	2,006	295	1,490
6 to 10	18,627	181	97.2	1,410	219	1,550
11 to 20	39,195	93	23.7	2,137	148	690
Over 20	140,949	74	5.2	7,529	136	180
All ages	224,326	632	28.2	13,082	798	610

These tables, showing the difference in incidence of the three d
eases in the general population and in those exposed in the fam
with a case, are summarized in Table No. 65.

TABLE NO. 65.—*Comparative incidence of poliomyelitis, scarlet fever, and di
theria in persons exposed in the general population and in persons exposed
the family with a case of the disease.*

[Rates per 10,000.]

Ages.	Poliomyelitis, New York, 1916.		Scarlet fever, Providence, 1909-1911.		Diphtheria, Provi dence, 1909-1911.	
	Incidence in general population.	Incidence in persons exposed in family.	Incidence in general population.	Incidence in persons exposed in family.	Incidence in general population.	Inciden in perso exposed family
0 to 5	124.5	318.0	93.1	2,410	111.1	1,
6 to 10	20.8	127.0	115.0	2,570	97.0	1,
11 to 20	2.3	20.0	24.8	970	24.7	
Over 20	.4	2.0	3.2	120	5.2	
All ages	17.9	109.0	26.5	990	28.2	

From the summary in this table it will be seen that those in t
immediate environment of a case of poliomyelitis suffer from a mu
higher rate of incidence (approximately six times as great) th
does the general population. The difference is greatest at the ag
between 11 and 20.

In scarlet fever and diphtheria, however, the increased liability
infection of those in the family with a case is much more strikin
In scarlet fever the incidence among those in the family with a ca
is thirty-seven times as great as in the general population; in dip
theria twenty-two times as great.

It should be borne in mind, of course, that the figures for scarl
fever and diphtheria refer to conditions in which the patie
remained at home during the entire illness. In poliomyelitis in Ne
York City, however, a large majority of the cases were remov
immediately upon diagnosis to an isolation hospital. In view
the fact that the secondary attack rate is about equal to that observ
in epidemics in which no such removal was practiced, and in furth
view of the fact that 60 per cent of the secondary cases devel
within four days after the primary case, just as in Wickman's seri
practically all of which were treated at home, this removal wou
not appear to have had any considerable effect on the developme
of secondary cases.

It would appear, therefore, that in poliomyelitis the recogniz
case of the disease is relatively a far less important source of infecti
than in scarlet fever or diphtheria.

TIME OF DEVELOPMENT OF SECONDARY CASES.

The time intervening between the development of first cases in families and the development of subsequent cases is shown in Table No. 66, which gives the number of cases developing each day after the onset of the original case, with percentages.

TABLE No. 66.—*Poliomyelitis, New York City, 1916—Interval between initial and subsequent cases in same family—Number of cases developing at designated intervals after the initial case.*

Boroughs.	Interval of days after initial case.															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Manhattan	13	10	5	3	8	10	5	5	5	1	1	2	....	....	1	....
Bronx	2	3	5	3	2	2	3	1	1	1	....	....	....	....	1	....
Brooklyn	39	21	26	29	21	25	12	9	11	6	4	3	2	3	....	1
Queens	6	8	10	5	11	7	6	....	4	1	2	2	1	....	....	....
Richmond	1	3	1	1	4	1	....	2	1	....	1	....	....	....	....	....
The city	61	45	47	41	46	45	26	17	22	9	8	7	3	3	2	1
Per cent of total	15.0	11.1	11.6	10.1	11.3	11.1	6.4	4.2	5.4	2.2	2.0	1.7	0.7	0.7	0.5	0.2

Boroughs.	Interval of days after initial case.										Total subsequent cases.
	16	17	18	19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	
Manhattan	....	....	....	1	1	......	1	......	......	......	72
Bronx	....	....	....	....	......	......	1	......	......	......	25
Brooklyn	1	2	2	....	1	7	......	......	1	1	227
Queens	2	1	....	....	1	......	......	......	......	......	67
Richmond	....	....	....	....	......	1	......	......	......	......	16
The city	3	3	2	1	3	8	2	......	1	1	407
Per cent of total	0.7	0.7	0.5	0.2	0.7	2.2	0.5	......	0.2	0.2	99.9

For comparison there is appended Table No. 67 giving similar information for the occurrence of subsequent cases of scarlet fever and diphtheria, taken from Chapin's reports:

TABLE No. 67.—*Scarlet fever and diphtheria, Providence, R. I., 1904–1913.—Interval between initial and subsequent cases in same family.—Number and per cent of cases developing at designated intervals after the initial case.*

	Interval in days after initial case.															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Scarlet fever cases	100	162	146	118	127	126	81	105	72	75	57	56	42	57	51	46
Per cent of total	5.2	8.4	7.6	6.1	6.6	6.5	4.2	5.4	3.7	3.9	3.0	2.9	2.2	3.0	2.6	2.4
Diphtheria cases	77	135	144	120	110	117	116	109	60	57	65	39	37	32	40	22
Per cent of total	4.5	8.0	8.5	7.1	6.5	6.9	6.8	6.4	3.5	3.4	3.8	2.3	2.1	1.9	2.4	1.3

	Interval in days after initial case.										All cases.
	16	17	18	19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 and over.	
Scarlet fever cases	31	32	36	24	163	72	63	31	26	34	1,933
Per cent of total	1.6	1.8	1.9	1.2	8.7	3.7	3.3	1.6	1.3	1.7	100
Diphtheria cases	18	32	29	20	168	70	25	23	21	13	1,699
Per cent of total	1.1	1.9	1.7	1.2	9.9	4.1	1.5	1.4	1.2	0.7	100

From this table it will be seen that 61, or 15 per cent, of subsequent cases developed on the same day as the original case, and 59.1 per cent developed within four days. Before the tenth day after the original case, 88 per cent of the secondary cases had developed, the remainder being scattered irregularly as far as the seventy-ninth day.

Wickmann gives a similar table, as follows:

TABLE No. 68.—*Secondary cases in families (excluding suspicious cases).*

	Interval by days.														Total.
	0	1	2	3	4	5	6	7	8	9	10	11	12	Over 12.	
Cases	12	22	15	14	11	7	9	7	5	5	5	1	2	12	127
Per cent	9.4	17.3	11.8	11.0	8.7	5.5	7.1	5.5	3.9	3.9	3.9	0.8	1.6	9.4	....

This table shows the same chronological distribution of the secondary cases as that for the New York series.

The percentages of total secondary cases developing each day after the onset of the primary case is shown in the accompanying chart. (Chart No. 14.)

The chart shows graphically the differences in the chronology of secondary onsets as compared with scarlet fever and diphtheria. It will be seen that the proportion of simultaneous onsets is much higher, and the percentages of cases occurring during the first five days considerably above those for the other two diseases.

SUMMARY.

Summarizing the evidence presented by the secondary cases, it would appear that the immediate environment of the known case is somewhat more dangerous than that of the general community in which the epidemic prevails. This difference, however, is not nearly so striking as in scarlet fever and diphtheria.

The evidence of the secondary cases as to incubation period is not conclusive, but would justify the general inference that it is apparently somewhat shorter than that of scarlet fever and diphtheria, and is probably as a rule less than 10 days.

CLIMATOLOGICAL CONDITIONS DURING THE EPIDEMIC.

The fact that epidemics of poliomyelitis occur usually during the summer months has long been recognized. Smaller outbreaks occur occasionally during the winter months, but all the historic epidemics have occurred during the late spring, summer, or fall. In this respect the epidemic of 1916 was quite typical, beginning early in May and ending about November 15.

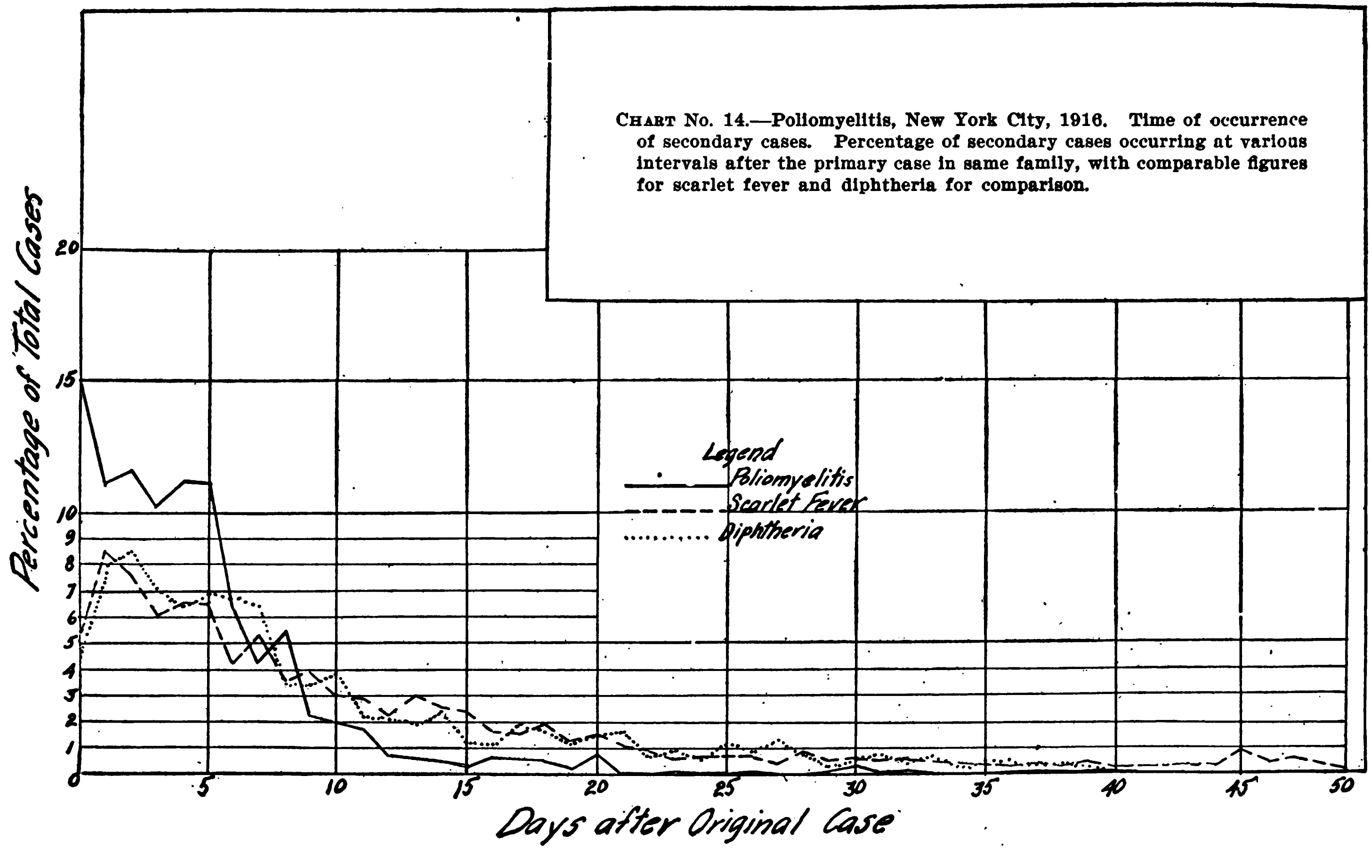


CHART No. 14.—Poliomyelitis, New York City, 1916. Time of occurrence of secondary cases. Percentage of secondary cases occurring at various intervals after the primary case in same family, with comparable figures for scarlet fever and diphtheria for comparison.

The temperature, rainfall, and other climatological conditions isting during the period of the epidemic, as recorded by the Uni States Weather Bureau at New York City, are presented in Tab Q and R (appendix). Table Q gives the maximum, minimum, a mean temperatures, with the precipitation in hundredths of an in for each day from May 1 to October 30, while Table R gives monthly summary of conditions for each of the six months.

As will be seen from these tables, May and June were sligh cooler than usual, with an excessive number of cloudy days, a more than normal rainfall. July was somewhat warmer and son what drier than usual, while August was excessively hot and d September and October were quite seasonable as to temperature, b somewhat deficient in rainfall.

During May and June, therefore, when epidemic conditions we becoming established, the unusual feature of the weather was in cessive cloudiness and rainfall, with somewhat abnormally low te peratures. The abnormal conditions of August came after the cr of the epidemic had been reached, and did not affect, apparent the downward course of the epidemic. It is of interest, however, note that conditions in August are described by the section direct of the Weather Bureau as "the hottest since 1906 and the driest sir 1907." The previous large epidemic of poliomyelitis in New Yo City occurred in 1907. The effect of the dry weather of Augu 1916, however, could not have been considerable, in view of the fa that the crest of the epidemic was passed at the beginning of th month.

The relation of temperature and rainfall to the onset of cases shown graphically by the accompanying chart (Chart No. 15). T cases, mean temperature, and rainfall are shown for averages of fi day periods. It will be seen that the curve of the epidemic, in ge eral, lies within the curve of temperature, the rise occurring son what more slowly than the rise in temperature, the fall beginni before the crest in temperature and with much more rapid desce The very considerable variations in temperature, as shown by t five-day averages, were without apparent effect on the course of t epidemic. As will be shown later, the epidemic followed qui definite mathematical relationships in its rise and fall, apparent independent of any but the widest seasonal variations in climat logical conditions.

The relation of rainfall to the course of the epidemic is not markable except for the general observation that the rise of the e demic occurred during conditions of excessive moisture and the fa during conditions of excessive dryness. This is at variance with t view of those who would ascribe the transmission of the disease the influence of dust.

SUMMARY.

The general relations of temperature to the course of this and other epidemics of poliomyelitis can not, of course, be overlooked, but it should be borne in mind that the epidemic in New York City was only part of the general outbreak extending over several States, and that while the epidemic was declining in New York City it was rising in other parts of the infected territory. Even within the limits of Greater New York the same phenomenon was observed, the epidemic in the Borough of Richmond having declined markedly during the end of July, while in all the other boroughs it was still on the increase.

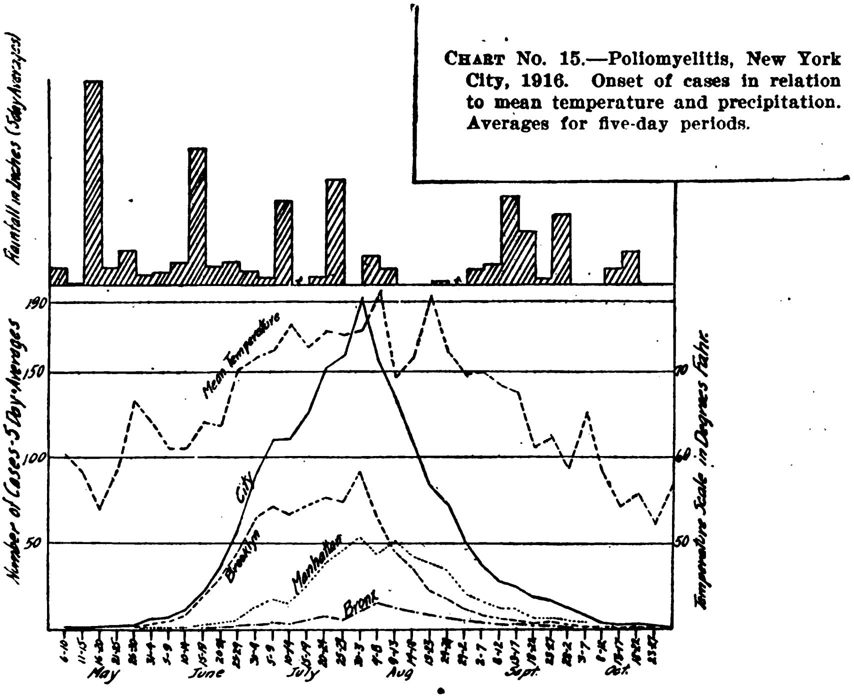


CHART No. 15.—Poliomyelitis, New York City, 1916. Onset of cases in relation to mean temperature and precipitation. Averages for five-day periods.

MATHEMATICAL RELATIONSHIPS OF THE EPIDEMIC.

It is quite evident from even a casual inspection of the graph of the course of the epidemic in New York City that the cases, week by week, tend to lie along a smooth curve. The general shape of this curve, as plotted on ordinary coordinate paper resembles that of a logarithmic function. The figures for cases by weeks were therefore plotted on logarithmic ordinate paper—that is, paper the ordinate scale of which is ruled proportionate to the logarithms of numbers rather than to the numbers themselves, the abscissa scale remaining as usual. The results of plotting the number of reported cases and of onsets by weeks on such paper are shown in the accompanying chart. (Chart No. 16.)

It will be seen that when onsets of cases are so plotted the points tend quite regularly to lie along a straight line from the beginning of the epidemic to the week ending July 8, when the direction of the line suddenly changes its angle with the base, becoming more acute, until the week of August 5, when the final decline began. After this time the points again lie on a straight line to the end of the epidemic. The weeks of October 14, 21, and 28 depart markedly from the line, due perhaps to the fact, previously referred to, that records of all cases occurring toward the close of the epidemic were not received prior to the closing of work.

The points made by the number of reported cases by weeks also tend to lie along a straight line similar in its general aspects to that made by onsets, but considerably later in the beginning of the epidemic, this lag gradually decreasing until it reaches an interval somewhat less than a week. The remarkable regularity in the rate of increase and decrease in cases is of great interest. The rate as shown by the inclination of the line, both ascending and descending, is capable of exact mathematical expression. If comparable information for other large epidemics were available, such expression might reveal constant relationships.

Roughly speaking, the curve shows that the number of cases tended to double each week during the first 10 weeks, and to double in about 4 weeks for the following 4 weeks. During the decline the number of cases decreased by half about every 2 weeks.

In this connection it may be stated that the epidemic in Newark, N. J., the largest urban outbreak outside of New York City, shows approximately the same rate of increase, though a more rapid rate of decline. It is much to be regretted that similar statistics for other epidemic diseases are not available at this time.

It would appear, therefore, that a case of poliomyelitis, either paralytic or abortive, since there is no reason to suspect that the relation between the numbers of the various types varies during the epidemic will, on the average, give rise to two other cases after an interval of approximately one week.

FORECASTING THE DECLINE OF THE EPIDEMIC.

The first plotting of the decline of the epidemic on logarithmic paper was made during the week ending September 30, using the number of cases reported for the weeks from August 12 to September 23, inclusive. The fact that the figures lay so regularly along a line

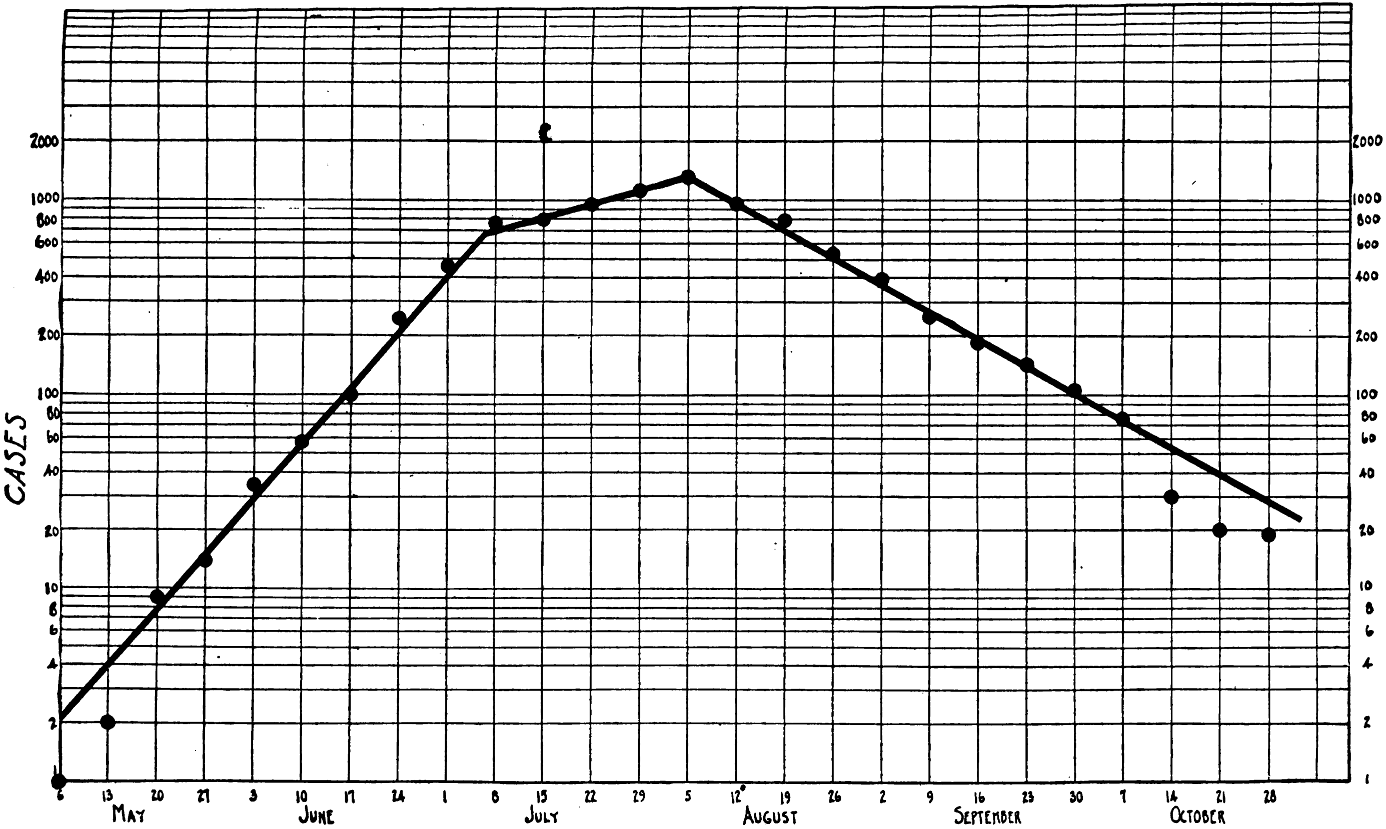


CHART No. 16.—Poliomyelitis, New York City, 1916. Reported cases, by weeks, plotted on logarithmic ordinates, showing the rise and decline of the epidemic.

was noted and taken to mean that the epidemic in its decline w following regular mathematic laws. It was therefore assumed th if the epidemic had continued for seven weeks to follow a defini mathematical formula in its decline it would continue to do so durin the remainder of the epidemic. These facts offered a reasonab basis for a forecast of the course of the epidemic, including the da

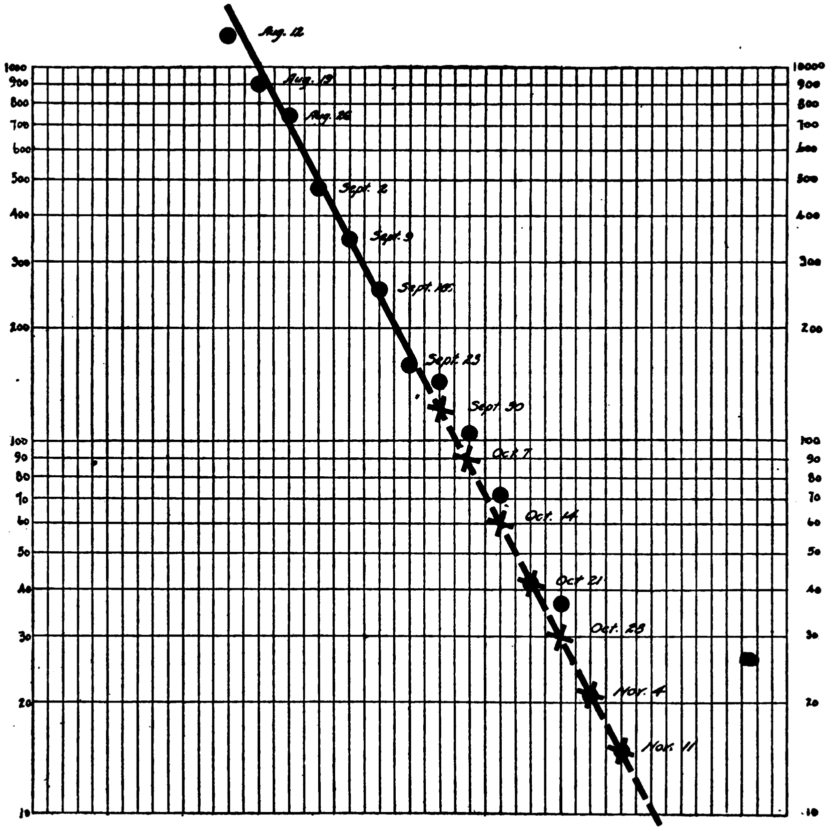


CHART No. 17.—Poliomyelitis, New York City, 1916. Forecast of decline of the epidemi Reported cases, by weeks, plotted on logarithmic ordinates, with line of decline pr dicted from decline prior to September 23, and line of actual decline.

Notation for chart:
Solid line: Actual decline prior to Sept. 23.
Dotted line: Predicted decline for remainder of epidemic.
Round dots: Actual number of cases by weeks.
Crosses: Predicted number of cases by weeks.

of return to normal endemic prevalence and the probable number c cases which would occur.

Such a prediction was made by the simple process of extendin the line of decline until it reached the line marking endemic inc dence, taking a rate of 10 cases per week to be endemic. The char (chart No. 17) shows the original plotting of the points, the lin of probable decline, as originally drawn and the points representing the actual number of cases which occurred each week.

As will be seen from the table of reported cases, the assumption that the course of the epidemic would follow the line it had previously marked out was amply justified by the facts. The end of the epidemic came precisely at the time predicted—the week of November 18—and the number of cases each week approximated very closely the number forecasted. In three of the eight weeks the number of cases actually reported coincide exactly with the number predicted.

The following table shows the number of cases predicted for each week covered by the forecast and the number actually reported:

TABLE No. 69.—*Number of cases predicted and number which actually occurred, for the end of the New York epidemic.*

Week ending—	Cases predicted.	Cases reported.
Sept. 30	120	146
Oct. 7	85	105
14	60	72
21	42	42
28	30	37
Nov. 4	21	21
11	15	15
18	10	4
Total	383	442

For a consideration of the facts presented above, it must be concluded that the progress of the epidemic was but little affected by minor factors. The progress from beginning to crest was quite regular, and the progress from crest to the end equally so.

It would appear also that it will be possible, in future epidemics in large cities, to predict with considerable certainty the course of the decline of the epidemic within a few weeks after the decline actually sets in.

B. INTENSIVE STUDY OF THE EPIDEMIC IN THE BOROUGH OF RICHMOND.

Supplementary to the studies made of the general epidemic in Greater New York, an intensive investigation was also made of the epidemic as it affected one borough. This study was undertaken with the idea of obtaining more detailed data concerning certain features of the epidemic. It was felt that the work would be incomplete unless all possible information could be collected and examined for at least some portion of the city.

The borough selected for this investigation was Richmond. By reason of its geographic separation from the rest of the city and its relatively small population, this borough, while not ideal for the purpose, seemed to offer less numerous difficulties than any of the others for an investigation of the kind contemplated. Studies of the character desired were not considered possible amid the complexities of other larger and more densely populated boroughs.

DESCRIPTION OF THE BOROUGH.

The Borough of Richmond comprises the whole of Staten Island and lies southward some 5 or 6 miles across the bay from Manhattan. It is separated by a part of the bay from Long Island on the east, and on its western side lies close to the New Jersey shore, from which it is separated by a narrow channel. It is roughly triangular in shape, being about 13 miles long by about 8 miles wide and contains some 70 square miles. Topographically the island is marked on the northeast by two ranges of hills and to the south it slopes to the coastal plane. On the west side there exist rather extensive salt marshes.

As previously noted, Richmond is connected with Manhattan, Brooklyn, and New Jersey by several ferries which carry back and forth daily large numbers of people. There are beaches and other resorts on the island, which during the summer months attract many visitors from other congested parts of the city.

All parts of the island are well connected by trolley and steam cars. The Baltimore & Ohio Railroad has large yards on the northeast coast, this being one of their freight terminals. There are numerous docks and considerable shipping. The industries are not very important. They include shipbuilding, a large linoleum factory, a plaster mill, and one or two breweries. In addition there is some truck gardening and farming.

The total population is 98,634 (New York State census, 1915). The population of the island is largely collected in a series of villages which lie along the coast—New Brighton, West Brighton, Port Richmond, and Mariners Harbor on the north; Tompkinsville, Stapleton, Clifton, Rosebank, Fort Wadsworth, and South Beach on the east; and Tottenville on the southwest shore. The villages which lie along the north and northeast shore are in reality continuous and form one unit of population. The interior of the island contains a few small hamlets but for the most part is essentially rural. There is a considerable foreign element—mainly Irish, Italian, and German, but other nationalities are well represented. The distribution and density of the population according to wards is as follows:

TABLE 70.—*Distribution of population by wards.*

Ward.	Acreage.	Population.	Density per acre.
	3,340	30,193	9.0
	4,130	17,225	4.1
	10,050	23,446	2.3
	8,180	15,112	1.8
	10,900	12,658	1.1

Staten Island is to a great extent a residential section. Even in he villages most people live in detached houses. Apartment houses nd tenements are rare. There are spots in some of the villages vhere considerable congestion occurs and where the population live nder poor sanitary conditions. Outside of the villages the conditions of life are practically rural.

Sanitary conditions on the whole are good. Milk and water suplies are equal to those of the other boroughs. In the villages garage collection is satisfactory. Facilities for the disposal of sewage re not adequate. Many vaults and cesspools exist. In the central art of the island sanitary conditions are those of a rural community. he typhoid death rate is low.

METHODS AND SCOPE OF STUDY.

The data for this study were collected by a number of service offiers, one of whom visited each case as it was reported, and obtained, o far as practicable, the information indicated upon the case card resented below:

TATE__________________ COUNTY__________________ LOCALITY__________________

Case No.______

POLIOMYELITIS. CASE RECORD.

ame of patient________________________________Age________Sex________
ddress at onset____
ow long resident at above address?_______________In community?_______________
revious and subsequent residences, with dates__________________________________
ttending physician____
ate of onset_______________Of report_______________Of investigation_______________
aralysis____________________________Extent at worst_______________________
asis of diagnosis if not paralyzed____
utcome to date: Acutely ill_____Improved_____Recovered______Died______Date______
lassification: Paralyzed_____________Abortive_____________Suspicious_____________
rophylaxis: Removal_____________Isolation_______________Efficiency_______________
irect contacts other than family: Number of adults____________Children____________
umber of families represented (total in family of patient, including servants, guests, etc.):
Adults (over 20 years): Males, number____________Females, number____________
Males: Age of each____
Children: Females, age of each____
chool attended within 30 days prior: By patient__________________________________
Grade__________Room__________By others in family__________________________
Grade__________Room__________
ccupations of working members of household_______________Place_________________

(NOTE.—Refer by asterisk (*) to notes on reverse of sheet.)

Contact with.	Definite case.	Suspected case.	Infected district by visit.	People from infected district.	General public.
Direct					
Indirect					

Summarized details of contacts indicated ____
Nearest previous case ____
Milk supply: Source ____

ENVIRONMENT.

Neighborhood: General character and population ____
Premises: Number of families in house ____
Tenement ____ Apartment ____ Detached ____ Semidetached ____ Yard ____
Brick ____ Frame ____ Stone ____ Age ____ Repair ____
Cellar ____ Basement ____ Floor: Cement ____ board ____ earth ____ use ____
Outhouses on premises ____ Uses and condition ____
Sewage disposal ____ Garbage disposal ____
Stables: On premises ____ adjoining ____ distance nearest ____
Animals and fowls on premises ____
Association with animals ____
Sickness or death of animals or fowls ____
General cleanliness of premises: Excellent ____ good ____ fair ____ poor ____
Probable prevalence of—house flies ____ stomoxys ____ fleas ____
Probability and evidences of rat infestation ____
Other illness in family ____ Among neighbors ____
Special features of case ____

As the value of such information depends upon a thorough understanding of the purposes for which it is desired and upon its uniformity, special attention was paid to the organization of this canvass. The officers for this duty were assembled beforehand for minute explanation and discussion of each detail, and in order to insure uniformity of methods the canvass was started first by two officers working together, each of them then taking another for preliminary instruction, and so proceeding until each man had had actual experience in the work before undertaking it alone.

No attempt was made to undertake a clinical study of the cases visited except in so far as was necessary to verify the diagnosis and to ascertain approximately the extent of the resulting paralysis. The cases were classified as paralytic, abortive, and suspicious. While none of the abortive cases showed any demonstrable paralysis they all exhibited nervous symptoms sufficiently distinct to justify the diagnosis of poliomyelitis. These may be all fairly regarded as true cases of the disease. Great care was exercised in the classification of these cases. They are listed in some places separately from the paralyzed cases, not because of any doubt as to the correctness of the diagnosis but simply for the sake of uniformity with other similar statistics. The cases designated as "suspicious" include (*a*) cases not accessible for careful study during the acute stage of the illness and without history sufficiently clear to justify the diagosis; (*b*) cases not reported to the health department and incientally learned through neighbors and acquaintances as having sufered with the disease; (*c*) cases of illness occurring in families here the disease existed but which did not present symptoms ufficiently definite for a diagnosis. It is very likely that a majority f these suspicious cases were real cases of poliomyelitis. It has been hought best, however, to class them separately from the paralytic nd abortive cases, and in many tables, as will appear, they are not onsidered at all.

SUMMARY OF CASES.

The following is a summary of the cases investigated:

'aralytic cases	266
bortive cases	24
Total positive cases	290
uspicious cases	38
Total cases investigated	328

Of these 328 cases, 194 were males and 130 were females. In four ases the sex was not recorded. Of the 328 cases, 56 terminated 'atally, a case fatality of 17 per cent. Excluding suspicious cases, he case fatality was 19.3 per cent.

The figures given in this study do not correspond precisely with he figures previously given for Richmond Borough in the study of he general epidemic for the entire city. The total number of cases 'or the borough given in the tables of the general epidemic are 296.)ther minor variations will be noted.

These discrepancies are due to the fact that the information in the wo sets of figures was collected by entirely different methods and ersonnel. The fact that the figures for Richmond Borough, colected so carefully by an especially trained personnel, differ so little rom the information collected by the department of health, under he routine used for the entire city, indicates strongly that the departnent's information is as accurate as could be expected for so large a umber of cases.

The extent of these discrepancies is indicated by Table No. 71, vhich gives the dates of onset as determined in the two series of data. The differences are inconsiderable.

TABLE 71.—*Poliomyelitis in the Borough of Richmond—Onset of cases, by days and weeks, according to the records of United States Public Health Service and New York City health department.*

Day of onset.	May.		June.		July.		August.		September.	
	P. H. S.	D. of H.	P. H. S.	D. of H.	P. H. S.	D. of H.	P. H. S.	D. of H.	P. H. S.	D. of H.
1	0	0	0	0	5	8	2	4	1	2
2	0	0	1	0	5	0	4	3	2	3
3	0	0	0	1	3	2	2	2	0	0
4	0	0	0	0	4	4	2	1	2	1
5	0	0	1	1	6	5	1	0	0	1
6	0	0	0	0	7	5	1	1	0	0
7	0	0	2	0	8	9	4	3	0	1
8	0	0	0	1	9	8	4	5	0	0
9	0	0	0	0	10	7	4	2	1	1
10	0	0	0	0	6	12	3	1	0	0
11	0	0	1	1	7	4	3	3	0	0
12	0	0	0	1	7	6	5	4	0	0
13	0	0	0	0	6	6	2	2	0	0
14	0	0	0	1	8	13	2	1	0	0
15	0	0	4	1	8	8	1	2	0	0
16	0	0	1	4	10	11	2	3	0	0
17	0	0	0	0	6	8	0	0	0	0
18	0	0	0	0	5	3	1	1	0	0
19	0	0	1	0	7	7	5	4	0	0
20	0	0	0	2	14	9	0	2	0	0
21	0	0	2	0	6	9	1	1	0	0
22	0	0	1	3	8	8	2	0	0	0
23	0	0	0	0	3	2	0	1	0	0
24	0	0	3	2	9	11	0	0	0	0
25	0	0	3	2	3	3	0	0	0	1
26	0	0	2	6	5	5	0	0	0	0
27	0	0	3	3	2	6	1	3	0	0
28	0	0	4	0	5	5	1	0	0	2
29	0	0	4	4	5	7	0	0	0	0
30	0	1	3	3	3	2	0	0	0	1
31	0	0	0	0	3	4	2	0	0	0
Total	0	1	36	36	193	197	55	49	6	13

ONSET BY WEEKS.

Week ending—	Public Health Service figures.	Department of health figures.
June 3	1	2
10	3	2
17	6	8
24	7	7
July 1	24	26
8	42	33
15	52	56
22	56	55
29	32	39
Aug. 5	17	16
12	24	19
19	13	13
26	3	4
Sept. 2	7	8
9	3	4
16	0	0
23	0	0
30	0	4
Total	290	296

ORIGIN AND COURSE OF THE EPIDEMIC.

In the description of the course of the general epidemic throughout the city frequent reference has already been made to the epidemic in Richmond Borough, and the chronology of the cases has been given

some detail in the tables already presented. It is felt, however,
t some more detailed description of the origin and course of the
demic in this particular borough may be of advantage.

The first case of the disease reported in Richmond Borough had
onset June 2[1] in the village of Rosebank on the northeast shore.
is case was succeeded by four others, with onsets as follows: June
1; June 7, 2; and June 11, 1. These four cases occurred one in
apleton and one in Rosebank on the northeast shore, and one in
rt Richmond, and one in Mariners Harbor on the north shore.
eference to the map will show how widely these cases were sepa-
ted. (Map No. 12.) After an interval of four days another group
five cases occurred, as follows: June 15, 3 cases; June 16, 1 case;
d June 17, 1 case. These occurred in South Beach, Rosebank, and
lifton on the northeast shore, Graniteville in the interior of the
land, and Tottenville on the southwest shore. It will be seen, there-
re, that the first 10 cases of the epidemic, which occurred during the
st half of June, were widely scattered throughout the island, in-
lving seven different villages.

Some detailed history of these 10 cases, with record of contact, is
ven below:

Case with onset June 2: An Italian child in Rosebank. Father a laborer em-
oyed by the gas company, and works in various parts of the island. One son
ives a garbage cart for the city, and one is a clerk for the gas company at
ifton. No known contact, either direct or indirect, with any previous case.
ild had not been out of the neighborhood on any visit.

Case with onset June 5: An American child in Stapleton. Father a laborer in
nusement park at South Beach. There are five children, but all too young for
ork or school. No evidence of any direct or indirect contact with any other
se. It is probable that an insurance agent from Brooklyn may have visited
e house, but definite information was not obtainable. Neither the child nor
e parents had recently made any visits to any other part of the city.

Case with onset June 7: Nationality of father Irish. Case occurred in Rose-
nk. Father is a machinist in the shops at Clifton. Two other children attend
hool in Rosebank. There is no evidence of either direct or indirect contact
ith any other case, nor is there evidence of any visits to any other part of the
ty or elsewhere.

Case with onset June 7: A child of American parents in Port Richmond. The
ther is a workman with a refrigerator company in Manhattan. One brother
a machinist in a shop in Bayonne, N. J. There is no evidence of direct or
direct contact with any previous case. The mother had visited West Hoboken,
. J., several times, and also had gone to church at Port Richmond. No other
sits had been made.

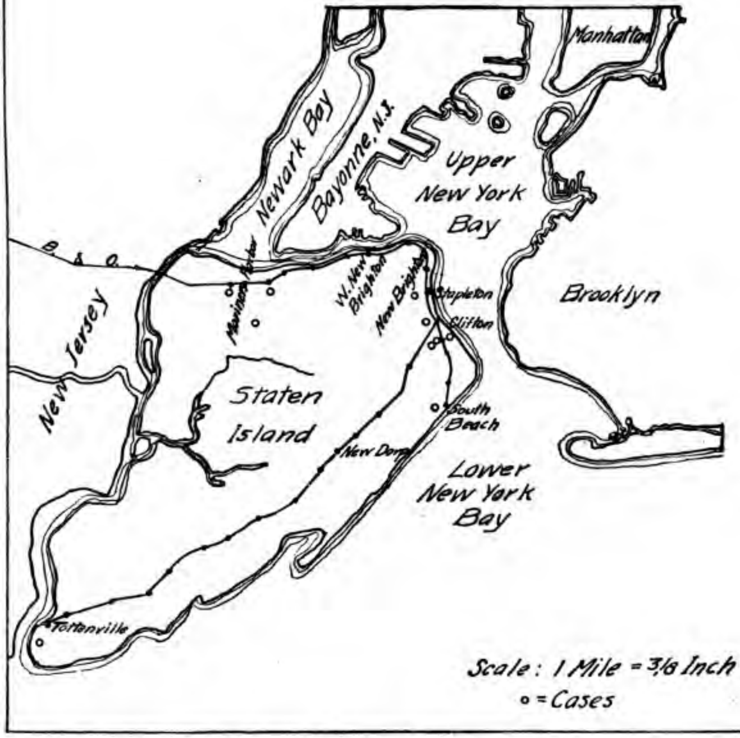
Case with onset June 11: Father of child Austrian-Polish. Case occurred at
ariners Harbor. The father is a laborer in a soap factory at Mariners Har-
or, as also were some boarders in the family. No data were obtainable with
gard to contact or visits, although the attempt was made to do so through an
terpreter.

---

[1] May 30, according to records of department.

Case with onset June 15: Child of American parents. Case occurred at S Beach. Father a merchant at South Beach. No evidence of either direc indirect contact with any previous case. South Beach being a pleasure re the child probably came in contact with a number of visitors.

MAP No. 12.—Poliomyelitis New York City, 1916. Location of cases occurring in June in Borough of Richmond.



Case with onset June 15: Child of Jewish parents (Russian Hebrews). C occurred at Clifton. The father is a tailor and has his shop in his reside No evidence of direct or indirect contact with any previous case. Child taken to South Beach for a visit first week in June and to New York City June 14. No other visits of any kind recorded.

Case with onset June 15: Child of American parents. Case occurred at Rosebank. The father is a clerk in a dry goods store in Manhattan. The other children attend public school. No evidence of direct or indirect contact with any previous case, and no visits except to local stores.

Case with onset June 16: Child of American parents. Case occurred at Graniteville. The father is a painter and works at Port Richmond. One child attends public school. No evidence of direct or indirect contact with any previous case. Child was cared for by friend. Mother lives in Union Hill, N. J., and visited the child every two weeks previous to illness. Child was also taken to visit a relative at Richmond weekly.

Case with onset June 17: Child of American parents. Case occurred at Tottenville. The father is a fireman in the city fire department at Tottenville. Other children attend public school. On May 30 a child died next door, which was possibly a case of poliomyelitis. In the adjoining house every Sunday there are a number of visitors from Brooklyn who bring children with them. The child played with these children. Family made no visits except to the beach at Tottenville one day. Mother had visited in New Jersey early in June.

Map No. 12 shows the distribution of these early cases. It was impossible to trace any very direct connection between these cases individually and cases in the other boroughs.

The epidemic developed, somewhat irregularly, during the remaining days of June, prevailing largely in the two adjoining villages of Clifton and Rosebank on the northeast shore. These two villages accounted for more than one-third of all June cases.

With the closing days of June and in early July an increasing number of cases occurred in West Brighton, and Port Richmond on the north shore; and as July advanced, New Brighton on the north and Stapleton, Arrochar, and South Beach on the northeast shores also reported numerous cases. Clifton and Rosebank which had suffered relatively so much in June, now showed very few cases. With later July and early August the villages of the north and northeast shores continued to report many cases, the epidemic reaching its crest on July 20. As the month of August advanced the epidemic declined somewhat in these villages and spread took place toward the interior and southern end of the island. This part of the island, however, did not suffer severely at any time in the epidemic. During August there was a general decline in the number of cases reported and the epidemic practically terminated in early September.

In its relation to the general epidemic of the greater city, the epidemic of Richmond began early, reached its crest promptly, and declined rather rapidly. In duration the epidemic in this borough was the briefest of all the boroughs. This borough is perhaps more comparable to a single assembly district of Brooklyn or of Manhattan. In any such a unit of population the epidemic would naturally be expected to run its course more rapidly than in a larger unit.

Chart No. 18 shows the date of onset of cases, classified as pa
lytic, abortive, and suspicious, as well as the date of onset of the fa
cases.

GEOGRAPHIC DISTRIBUTION OF CASES.

The spread of the epidemic has already been briefly described. T
spot map, with the map showing distribution of population (Ma
T and U, appendix) gives an adequate idea of the general distrib
tion of the cases.

With regard to transportation routes the disease followed a fai
regular course, even though the population units concerned are sm
and traffic relations somewhat complex. A study of the cases
wards makes this apparent. The five wards of the island are in
cated on the spot map. The onsets by wards, by weeks, were as f
lows:

TABLE No. 72.—*Richmond Borough, onsets by wards and by weeks.*

Week ending—	Ward 1.	Ward 2.	Ward 3.	Ward 4.	Ward
June 3	0	0	0	1	
10	0	1	1	1	
17	1	0	2	4	
24	0	0	1	5	
July 1	4	2	6	11	
8	15	4	14	9	
15	25	7	15	5	
22	16	15	13	8	
29	10	7	5	9	
Aug. 5	7	3	2	4	
12	5	4	5	7	
19	1	4	2	5	
26	0	0	1	2	
Sept. 2	0	0	4	0	
9	1	1	1	0	
Total	86	48	72	71	

This is shown graphically in chart No. 19. The true march of t
epidemic in the various wards is best shown by the dates on whi
the middle cases occurred. Arranged chronologically, we have:

	Middle cases.
Ward 3	July 14
1	July 15
4	July 16
2	July 20
5	July 24

The middle cases of wards 3, 1, and 4 occurred almost simultan
ously, while those of wards 2 and 5 came distinctly later. From
consideration of these data it would seem apparent that in its sprea
the epidemic showed a distinct relation to traffic routes and distrib
tion of population and followed in a general way the course whi
might have been expected.

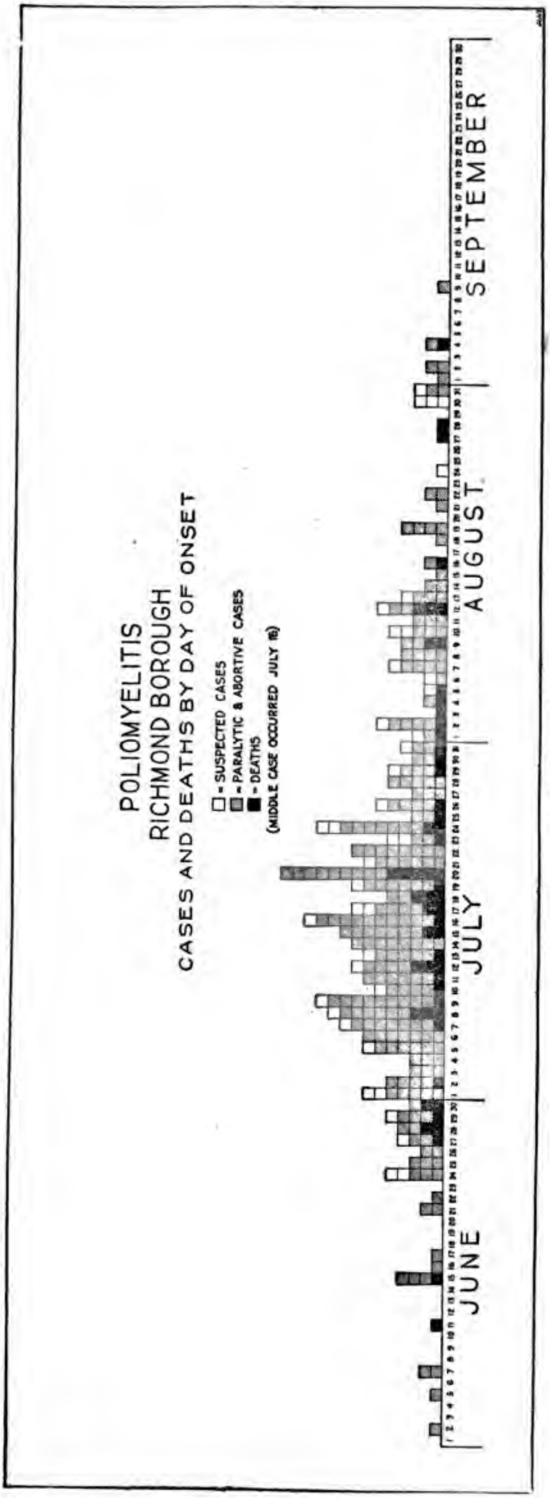

POLIOMYELITIS
RICHMOND BOROUGH
CASES AND DEATHS BY DAY OF ONSET
☐ - SUSPECTED CASES
▨ - PARALYTIC & ABORTIVE CASES
■ - DEATHS
(MIDDLE CASE OCCURRED JULY 16)
JUNE
JULY
AUGUST
SEPTEMBER

CHART No. 18.

The incidence rate by wards is shown in the following table:

TABLE 73.—*Richmond Borough, incidence by wards with rates (suspicious cases excluded).*

Ward.	Population.	Number of cases.	Rate per 1,000 population.
1	30,193	86	2.84
2	17,225	48	2.78
3	23,446	72	3.07
4	15,112	71	4.69
5	12,658	13	1.02

The variations in incidence are perhaps no greater than might be expected from the small units of population which are involved.

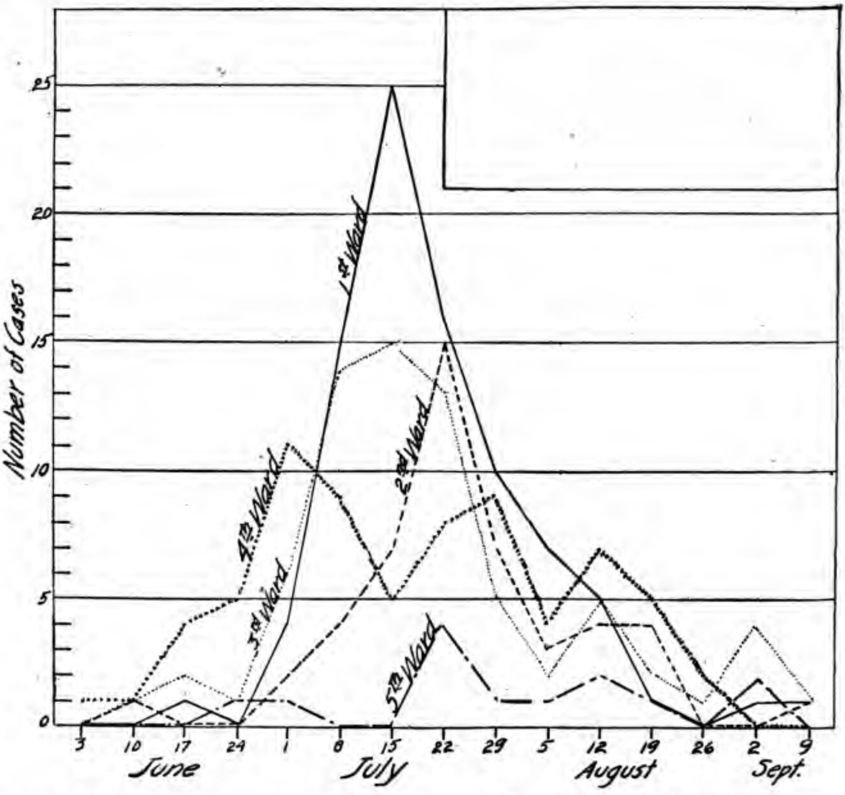


CHART No. 19.—Poliomyelitis, Borough Richmond, New York City, 1916. Onset of cases by weeks, by wards.

DISTRIBUTION OF CASES ACCORDING TO NATIONALITY.

Cases have been classified according to nationality of parents, and rates of incidence computed, using as a basis for the general distribution of the various nationalities the figures given in the United States census for 1910. The results are given in the following table.

The variations in incidence as between the different nationalities shows nothing striking.

TABLE 74.—*Nationality of cases, with incidence ratio, per 1,000 population.*

Nationality of cases.	Number of cases.	Racial stock, population United States census, 1910.	Rate per 1,000.
Americans (including 2 colored)	138	29,456	4.5
Italian extraction	41	7,662	5.3
German extraction	23	13,959	1.7
Russian extraction	23	3,378	6.8
Irish extraction	15	13,700	1.1
Scandinavian extraction	15	3,427	4.3
English extraction	13	4,385	2.9
Austrian extraction	12	1,656	7.2
Scotch extraction	1	1,285	.7
Not listed	9		
Suspicious cases excluded	290		
Rate per 1,000 population for the borough	3		

RELATIONS TO ENVIRONMENTAL CONDITIONS.

In the table following is given a condensed summary of the environmental conditions found upon investigation of 290 true cases of poliomyelitis. On the whole it may be said that general sanitary conditions surrounding the population affected in the borough were good and no connection of consequence can be traced between the spread of the disease and local sanitary conditions.

Summary of environmental conditions.

[Found from investigation of 290 cases of poliomyelitis, paralytic and abortive.]

	Cases.
Density of population in neighborhood:	
Dense	83
Medium	95
Sparse	110
No data	2
General sanitation of neighborhood:	
Good	123
Fair	105
Poor	59
No data	3
Number of families in house:	
1 family in house (including 1 case in institution)	149
More than 1 family in house (including 1 case in boys' camp and 2 cases in hotels)	137

(NOTE.—More than one family in house includes all two or three family houses, as well as apartments and tenements, which have a common entrance. One family in house includes all houses, detached or otherwise, which have a private entrance.)

	Cases.
Character of house:	
Living in detached houses	214
Living in semidetached houses	46
No data	30
Sewage disposal:	
Inside toilets with sewer or cesspool connections	224
Outside toilets without such connections	62
No data	4
Domestic animals on premises:	
A representative of one or more of the following species: horses, dogs, cats, chickens	137
Other domestic animals, such as goats, cows, rabbits, etc	15
No animals of any kind	136
No data	2
Proximity of stables:	
On premises	16
Within 100 yards of house	124
Between 100 and 300 yards away	36
No stables near	112
No data	2
Sanitary conditions on premises:	
Good	121
Fair	106
Poor	61
No data	2

RELATIONS TO MILK SUPPLY.

There is given below a table summarizing the information collected regarding the milk supply of families having poliomyelitis. More detailed data are shown in Table No. 75.

SUMMARY.

Number of patients concerning whom there was reliable data in regard to the use of milk, total		272
Number using cow's milk (fresh)	240	
Number using condensed milk only	12	
Number using condensed milk plus breast feeding	1	
Number breast feeding only	8	
Number using no milk of any kind	11	
		272
Number using no cow's milk		32

TABLE 75.—*Milk dealers supplying families in which cases occurred.*

Sources.	Cases.	Quarts sold daily.	Cases per 1,000 quarts sold daily.
1. Dairy	129	14,500	8.9
2. Dairy	20	3,500	5.7
3. Dairy	6	1,400	4.3
4. Dairy	15	1,340	11.2
5. Dairy	9	1,200	7.5
6. Dairy	11	1,060	10.4
7. Dairy	7	800	8.7
8. Dairy	5	504	9.9
9. Board of health station	1	300	3.3
10. Dairy	1	280	3.6
11. Store	2	250	8.0
12. Dairy	1	150	6.7
13. Store	1	140	7.2
14. Board of health station	2	108	18.6
15. Dairy	1	105	9.5
16. Dairy	1	90	11.1
17. Dairy	1	35	28.6
18. Store	1	12	83.4
19. Farm	5	8	625.0
36. Miscellaneous	21		
37. Private cows	9		
38. More than one source	9		

Very brief consideration of the above summary and the table should make it obvious that in this study milk could not have been a factor of any consequence in the spread of the disease.

There is indeed in the table only 1 instance which should arouse suspicion. One source (farm 19) supplied 8 quarts daily to families having 5 cases, with a proportion of 625 cases to every 1,000 quarts sold. A careful investigation of this instance showed that there was a paralytic case on this farm, and that this farm supplied milk to one family which developed 3 paralytic cases. It was also established, however, that there was considerable personal communication between the people of the farm and the people so seriously affected. The dates of onsets for the cases concerned were, moreover, quite significant, and suggested quite strongly that contact was a more important factor than the milk supply.

OCCUPATIONS OF WAGE EARNERS IN FAMILIES HAVING CASES.

The occupations of wage earners in families having cases were carefully tabulated in 290 cases. The details are too voluminous to reproduce here. It must suffice to say that an examination of the data showed nothing significant.

RELATIONS TO SCHOOLS AND INSTITUTIONS.

The school question in Richmond Borough was investigated in detail. The schools closed on June 30. Inquiry was made concerning the onsets among school children up to July 14. This inquiry included the public schools, the parochial schools, and private schools, with a total registration of 18,614 pupils, exclusive of private schools.

Of the 41 schools there were 21 which had no cases among th families of those attending. Of the other 20 schools there were cas among the families of those attending, occurring either in the perso of those attending or of some other member of the family.

There were only four schools with more than one case in the fam lies of those attending, the highest number represented by any or school being four cases. It is quite evident from these figures th the schools did not play any demonstrable part in the disseminatio of the disease.

In this connection comment may be appropriate on the occurrenc of cases in institutions devoted to the care of children. There are si such institutions in Richmond Borough, with a total population of little over 2,000 children. Among these institutions there occurre only one case of the disease, from which apparently no secondar cases developed. This one case was of questionable diagnosis. Mo of these institutions were under a modified quarantine and kept u only restricted communication with the general public. It is matter worthy of note that even under such circumstances they shoul have escaped. This is in accord with observations, made and r ported by the department of health, for other parts of the city.

MULTIPLE CASES IN FAMILIES.

The following table shows the distribution of cases by families i Richmond Borough. The percentage of families showing more tha one case is, as usual, small. It is, however, 2.1 per cent greater tha the figures for the general epidemic. With the addition of suspiciou cases, which were not available for the general epidemic, the pe centage is practically doubled.

TABLE 76.—*Distribution of cases by families.*

EXCLUDING SUSPICIOUS CASES.

Families showing—	Number.	Cases.	Per cent of total families.	Per cen of case
1 case in family	244	244	92.8	8
2 cases in family	16	32	6.06	11
3 cases in family	2	6	.76	2
4 cases in family				
5 cases in family	1	5	.38	1
Total	263	287		

INCLUDING SUSPICIOUS CASES.

Families showing—	Number.	Cases.	Per cent of total families.	Per cen of case
1 case in family	239	239	86.0	73
2 cases in family	33	66	11.8	20
3 cases in family	5	15	1.8	4
4 cases in family				
5 cases in family	1	5	.36	1
Total	278	325		

Percentage of total families with more than 1 case (excluding suspicious)	7
Percentage of total families with more than 1 case (including suspicious)	14

This apparently disproportionate increase in the percentage of families with more than one case which is made by the addition of the relatively small number of suspicious cases, is due of course to the fact that suspicious cases are recognized as a rule only in association with paralytic cases of the disease. Such cases would therefore likely be discovered most frequently in families having other cases.

SECONDARY CASES IN FAMILIES.

Secondary cases and attack rates for the general epidemic are supplemented by the data for Richmond Borough as presented in Table No. 77. It will be noticed that in this table the secondary cases are analyzed more in detail with regard to the type of case than was possible for the general epidemic, also that the suspicious cases have been added.

These figures for the general epidemic are based on paralytic and, to some extent, on abortive cases. By reference to the table below it will be observed that the secondary attack rate in Richmond on the same basis is nearly doubled. If suspicious cases are considered this rate rises to 3.5 per cent; and if, in addition, only the most susceptible age period is considered (0 to 5 years) the rate becomes 13.9 per cent. The secondary attack rate, as so computed, is quite comparable to that of diphtheria or of scarlet fever.

TABLE 77.—*Family summary showing primary and subsequent cases.*

PARALYTIC, NONPARALYTIC, AND SUSPICIOUS CASES INCLUDED.

Ages.	Number of cases, primary.	Total persons in families involved.	Number persons exposed at age indicated.	Secondary cases.	
				Number.	Attack rate.
					Per cent.
0 to 5	226	484	258	36	13.9
6 to 10	29	221	192	9	4.6
11 to 20	6	146	140	2	1.4
Over 20	4	739	735		
Total	[1] 265	1,590	1,325	47	3.5
0 to 15	260	803	543	47	8.6

[1] 16 cases are omitted from consideration.

PRIMARY AND SECONDARY SUSPICIOUS CASES EXCLUDED.

Ages.	Number of cases, primary.	Total persons in families involved.	Number persons exposed at age indicated.	Secondary cases: Number.	Secondary cases: Attack rate.
0 to 5	225	479	254	21	8.2
6 to 10	28	219	191	3	1.5
11 to 20	7	144	137		
Over 20	2	729	727		
Total	262	1,571	1,309	24	1.8
0 to 15	259	796	537	24	4.4

TABLE 77.—*Family summary showing primary and subsequent cases*—Contd.

PRIMARY AND SECONDARY NONPARALYTIC AND SUSPICIOUS CASES EXCLUDED.

Ages.	Number of cases, primary.	Total persons in families involved.	Number persons eqposed at age indicated.	Secondary cases.	
				Number.	Attack rate.
0 to 5	212	453	241	16	6.6
6 to 10	25	204	179	1	0.55
11 to 20	7	130	123		
Over 20	2	691	689		
Total	246	1,478	1,232	17	1.37
Total, excluding simultaneous onsets	241	1,447	1,206	12	0.99
0 to 15	243	743	500	17	3.4

The inclusion of suspicious cases in such studies, by reason of uncertainty of diagnosis, has met with objection on the part of many epidemiologists. Their exclusion, however, may introduce another serious source of error. Frost (loc. cit.) has discussed the point as follows:

> The inclusion of definite abortive cases more than doubles the secondary attack rate. The inclusion of suspected abortive cases more than quadruples it, giving to poliomyelitis an apparent contagiousness comparable to that of scarlet fever and diphtheria, diseases which are generally considered highly contagious. It is evident, therefore, as stated before, that the question of contagiousness of poliomyelitis, as determined by epidemiologic studies, hinges largely upon the question of which are and are not cases of poliomyelitis. To omit from epidemiologic studies cases without paralysis, to use a somewhat exaggerated simile, is like undertaking to study the epidemiology of typhoid fever by considering only cases of hemorrhage. The inclusion of cases without paralysis is, on the other hand, open to the very reasonable objection that the epidemiology of the disease may thereby be confused by the consideration of cases in no way related to the disease in question.

By reason of our lack of definite knowledge of the incubation period of the disease all cases occurring in the family subsequent to the primary case are considered as secondary cases. Manifestly all are not true secondary cases. Many of them develop in so short a period of time after the primary case as to render it quite certain that they are not true secondary cases. On the other hand, however, we lack at present the knowledge necessary to exclude them.

GROUPING OF CASES.

In this connection it may be of interest to show the relations existing between the different types of cases in families where secondary cases developed. In this investigation there were 39 such families with a total of 86 cases. The grouping of these cases is shown in Table No. 78.

TABLE No. 78.—*Richmond Borough—Grouping of secondary and primary cases (all types included) as seen in 39 families.*

No.	Primary.			Secondary.		
	Paralytic	Abortive.	Suspicious.	Paralytic.	Abortive.	Suspicious.
1	1			1		
2			1	1		1
3	1				1	
4	1					1
5	1			1		
6		1		1		
7	1			1		
8			1	1		1
9	1					1
10	1			1		
11			1	1		
12	1			1		
13	1			1		
14	1			1	1	
15	1			2	2	
16	1					1
17			1		1	1
18		1		1		
19	1					1
20	1			1		
21	1					1
22	1					1
23	1			1		
24			1	1		
25	1				1	
26	1			1		
27	1					1
28	1			1		
29			1	1		
30			1	1		
31	1					1
32	1					1
33	1			2		
34			1	1		
35	1					1
36	1			1		
37	1			1		
38			1	1		
39			1	1		
Total	27	2	10	28	6	13

One or two of these groups deserve further comment.

The largest group of cases was five in a family. This family was composed of five children, mother, father, and servants. The family was in easy circumstances, occupied a detached house with large yard, fairly well isolated, and situated in a good residential neighborhood. The people maintained a quarantine and the children were kept at home. The father went to business in lower Manhattan each day, and he represented the only contact of consequence with the outside world. The children had onsets as follows: July 9, one, paralyzed; July 11 and 13, two, abortive; July 14 and 16, two, paralyzed.

Occurrences such as this are not uncommonly observed in poliomyelitis.

A somewhat similar and also not unusual history was obtained in case 261, which is not classed in this series among multiple cases in the family.

This was a well-isolated child of 13 years, the only child in the family. The father went daily to business in lower Manhattan. A friend had desk room in his office. This friend lived in a section o New Jersey where poliomyelitis was epidemic, and a few days befor the onset of case 261 his child apparently had an abortive case of th disease.

Another group of five cases occurred in a Y. M. C. A. camp of boy about 13 to 14 years of age. These cases all had sore throats an some of them were given diphtheria antitoxin. Onsets as follows August 30, three cases, suspicious; 31, one case with vomiting, sus picious; 31, one case, paralyzed, also had sore throat. The last tw cases were in very intimate association.

But for the paralysis which occurred in the last case, doubtles none of them would have been regarded as poliomyelitis. The evi dence strongly pointed to the fact, however, that they were all rea cases of the disease.

Another group of five cases occurred in three families. Thes three families all lived on the same street less than a block apart in very sparsely settled neighborhood. The contact between them wa intimate. The onsets of the cases were: First family, July 11, one paralyzed; July 23, one, suspicious. Second family, July 13, two paralyzed. Third family, July 22, one, paralyzed.

Still another group of five cases showed contact with case 12 a child with unrecognized, paralytic poliomyelitis who played aroun the streets with other children even after the occurrence of paralysi

Another group of cases has already been mentioned in discussin milk supplies. Farm No. 19 was the source of milk supply for family which developed three cases, all paralyzed. Onsets: Augu 12, 13, and 15; the family which owned the farm and supplied th milk had also developed a paralyzed case, with onset August There was rather free communication between these two families.

GENERAL CONTACT.

Detailed inquiry was made in all of the 328 cases comprising th series as to contact with previous cases of the disease. The resul of this inquiry constitute a mass of material too detailed for pr sentation in any but the most general terms. In Table No. 79 given an analysis of this material, subdivided according to the kin of contact and the type of the case, both primary and secondary.

TABLE No. 79.—*Borough of Richmond—Number and percentage of all cases of poliomyelitis, giving history of recent contact with previous cases (acute or convalescent).*

Kinds of contact.	Paralyzed cases showing contact.	Per cent of all paralyzed cases.	Abortive cases showing contact.	Per cent of all abortive cases.	Suspicious cases showing contact.	Per cent of all suspicious cases.	Total.	
							All cases showing contact.	Per cent of all cases
Direct contact, positive:								
(a) With paralytic case	22	8.2	5	20	11	26.3	38	11.5
(b) With abortive case	2	.75	0	0	1	2.6	3	.91
(c) With suspicious case	18	6.8	1	4.1	2	5.2	21	6.4
Direct contact, probable, with all cases	6	2.3	1	4.1	1	2.6	8	2.4
All direct contact	48	18	7	29.1	15	39.5	70	21.3
Indirect contact, positive:								
(a) With paralytic case	4	1.5	0	0	1	2.6	5	1.5
(b) With abortive case	0	0	0	0	0	0	0	0
(c) With suspicious case	1	.37	0	0	0	0	1	0
Indirect contact, probable, with all cases	16	6	2	8.3	2	5.2	20	6.1
All indirect contact	21	7.8	2	8.3	3	7.8	26	7.6
Total, all contact	69	25.9	9	37.4	18	47.3	96	29.2

Table based on: Paralyzed cases, 266; abortive cases, 24—290. Suspicious cases, 38. Total, 328.

By the term "direct contact" in this table is meant direct, personal, and supposedly physical contact between primary and secondary cases. "Indirect contact" includes association on the part of the secondary case with persons who have been intimately associated with a previous case, and also association on the part of members of the family of a secondary case with previous actual cases or with persons intimately associated with previous actual cases. "Probable contact" includes those cases in which neither direct nor indirect contact could be definitely established yet the collateral circumstances strongly indicated that such contact (direct or indirect) had actually taken place.

Of the 266 paralyzed cases, 22, or 8.2 per cent, had been in direct contact with previous paralyzed cases. In addition, 20, or 7.6 per cent, had been in contact with previous abortive or suspicious cases; while 6, or 2.3 per cent, showed probable contact with previous cases. In all, therefore, 42, or 15.8 per cent, of the 266 paralyzed cases had been in direct contact with previous cases, and 48, or 18.1 per cent, had been in contact or probable contact with such cases. Considering indirect contact, of the 226 paralyzed cases, 5, or 1.9 per cent, had been in indirect contact with previous cases, paralytic, abortive, or suspicious, and an additional 16 cases, or 6 per cent, had probably been in contact with such cases.

Of the 24 abortive cases 6, or 25 per cent, had been in direct contact with previous cases, and 1, or 4.1 per cent, had probably had such contact; 2, or 8.3 per cent, had probably been in indirect contact with previous cases.

Considering the 38 suspicious cases, 14, or 36.8 per cent, had been in direct contact, and 1, or 2.6 per cent, had probably been in such contact. Three suspicious cases, or 7.8 per cent, had certainly or probably had indirect contact with previous cases.

The percentage of contact shown by the paralyzed cases (25.9 per cent) is of great significance when consideration is given to the difficulties attendant upon the establishment of contact in a disease where so large a percentage of cases is usually unrecognized.

The high percentage of abortive and suspicious cases showing direct contact is due, of course, in large part to the fact that such cases, however common they may be in the general population, are recognized usually only when the proximity of a frank case attracts attention to their existence.

TIME INTERVAL BETWEEN PRIMARY AND SECONDARY CASES.

The incubation period of poliomyelitis is not definitely determined. In Table No. 80 is given the result of the Richmond Borough investigation with regard to this point.

An analysis of the figures given in this able shows practically the same results as does that for the general epidemic, and permits no more definite conclusions. The reader is therefore referred to the discussion of the general epidemic.

TABLE No. 80.—*Showing interval elapsed between dates of contact and onset.*

SECONDARY CASES IN WHICH CONTACT WAS ESTABLISHED.

Direct and indirect contact.	Interval by days.													Total.
	1	2	3	4	5	6	7	8	9	10	11	12	Over 12.	
All cases included	6	16	11	8	12	8	6	5	2	3	5	3	7	92
Suspicious cases excluded	5	12	8	8	11	6	4	4	2	2	5	1	7	75
Direct contact, all cases	5	12	10	7	8	6	4	5	2	2	2	3	3	69
Indirect contact, all cases	1	4	1	1	4	2	2	0	0	1	3	0	4	23

SECONDARY CASES IN FAMILIES (EXCLUDING SUSPICIOUS CASES).

	Interval by days.														Total.
	0	1	2	3	4	5	6	7	8	9	10	11	12	Over 12.	
	10	1	2	3	2	4	3	1	2	0	1	0	0	0	29

C. SUMMARY.

Summarizing broadly this section of the report on the general and detailed study of the epidemic of polimoyelitis as it occurred in New York City during the summer of 1916, it may be pointed out, st of all, that this is the most remarkable outbreak of this disease, th in size and in intensity, which has ever been reported. There ists no previous record of any epidemic of this disease reaching ch numbers or such incidence in any large population.

The intensity of the infection is indicated by the fatality rate hich, in comparison with previous experience, is noticeably high. his becomes even more significant when it is recalled that previous tality rates have been based largely on paralytic cases, while in is outbreak the reporting of cases was unusually complete, includ- g not only a certain number of mild abortive types, but even some spicious ones as well.

The figures for this epidemic represent by far the largest group cases for which uniform statistics have ever been collected. For is reason the compilation of the bare facts alone places us in pos- ssion of information of the highest value to all students of this fection.

It may be said, in general, that the epidemiologic features of this tbreak, while drawn on an exaggerated scale, are quite similar to ose of other epidemics which have been studied. Nothing, for ample, either peculiar or unique is evident in seasonal incidence, e distribution, comparative fatality rates at different ages and milar data. Likewise there is the usual absence of any apparent fects due to such special conditions as environmental surroundings, urce of milk and water supplies, occupation, prevalence of in- cts, or the presence of animals. There is also the usual lack of idence as to contact relationships between cases of the disease.

The time, place, or circumstances attendant upon the introduction any new and powerful strain of the virus are not apparent and ch a suspicion is open to grave doubt. The disease is endemic in ew York City, and the origin of the epidemic was quite possibly digenous. The explanation, however, as to why a virus long ex- tent and quiescent should have so suddenly developed epidemic po- ntialities, is equally obscure. Such an experience is, however, by no eans unique. The sudden development of epidemic proportions by demic diseases, without discoverable cause, is a common observa- on. We are, in truth, quite ignorant as to the principles which un- rlie such phenomena.

It would seem appropriate here to mention the relations which pear to exist between the prevalence of poliomyelitis previous to 16 and the incidence rates observed in this epidemic not only in the ty as a whole but also in its various boroughs. Such observations rongly support the prevalent belief that populations which have eviously suffered a high rate of prevalence develop a certain degree general immunity to the disease, the duration of which is, of urse, limited. The rate of incidence even in the densely populated areas of such a city as New York seems to confirm absolutely the opinion of low susceptibility in all populations.

One of the notable features of the epidemic was the remarkably definite geographical focus of the disease in Brooklyn, and the striking uniformity of its spread, both in rate and in intensity, from this point. Never before has this wave-like movement of an epidemic of this disease been so clearly defined. Along with this is also to be noted the mathematical regularity of distribution in different population units as shown in the studies of distribution by assembly districts.

The geometric progression in the rise and decline of the epidemic, so strikingly shown by the curve plotted on logarithmic paper, is both highly interesting and highly significant. Such a phenomenon would seem to indicate clearly that the disease was spread by constantly multiplying foci of infection. By inference, it may be suggested, with considerable degree of probability, that none of the careful prophylactic measures which were adopted influenced the epidemic to any appreciable extent.

Finally it seems most important to note that while the usual contact relationships as presented in this report have shown nothing unusual, yet the broader phenomena made evident in these studies by the mass movement of the epidemic and its mathematical relationships, would appear to point quite clearly to the great importance which contact, in its broad sense, may, and probably does play in the spread of this disease.

III. POLIOMYELITIS OUTSIDE OF NEW YORK CITY, 1916.

As has been stated, New York City in 1916 formed the original focus of an epidemic of poliomyelitis which ultimately extended and involved a wide area of territory. Having discussed the epidemic in the city itself, it is purposed in this section similarly to discuss conditions which developed outside of the city in those surrounding States which, so far as the spread of the disease is concerned, bore some relation to the New York City epidemic.

This section, like the one on the epidemic in New York City, is also divided into two general parts, namely, a general epidemiologic study, and an intensive epidemiologic study of individual cases in certain places.

However, these studies differ from those made in New York City in some particulars. In their scope, a great deal more territory is involved though there is no great difference in the number of cases concerned. The data available for the general study were necessarily less complete; and the intensive investigation could not be made always with the minute care possible in the Richmond Borough study. Nor, indeed, was it possible always in the intensive studies to see all cases in the territory included.

These limitations, however, have not been important enough to interfere materially with the purpose for which these studies were made. As already noted, their general object was twofold: First, to obtain information concerning early cases on the advancing fringe of the epidemic in order to establish, if possible, some relation between new foci of the disease and New York City; and, second, to obtain comparable data on the behavior of the epidemic in environment radically different from that of New York City. Some other matters also received attention, as will appear in the discussion.

A. GENERAL, STATISTICAL, AND EPIDEMIOLOGIC STUDY OF THE EPIDEMIC OUTSIDE OF NEW YORK CITY, 1916.

The data upon which the study is based were made available through the cooperation of the State and city health authorities of the States included in the study. In Massachusetts, Rhode Island, Connecticut, and New Jersey copies of the original report to the State board of health were made and forwarded day by day to our New York City office for tabulation and study. In New York State, through the courtesy of the State health department, daily an weekly reports of the number and location of reported cases wer furnished as soon as compiled. In Vermont, Maine, New Hampshir Delaware, Maryland, and District of Columbia copies of reports an all other available information were furnished after the close of th epidemic. Requests made to the commissioner of health of th State of Pennsylvania for similar information regarding the sprea of the disease in Pennsylvania were not granted. For this reason n statistics of the prevalence of poliomyelitis in Pennsylvania are included in this report.

THE EPIDEMIC AREA.

The extent of the epidemic area, as defined at the end of November when conditions had approached normal, included the whole of Ne England, the Middle Atlantic States, and Delaware, Maryland, an the District of Columbia. A few cases occurred in Virginia, thoug the total for the year in that State was not in excess of the usua endemic prevalence. Some cases also occurred in the Canadian Provinces lying to the north of the States of Maine, New Hampshire, an Vermont. During the winter of 1916–17 a circumscribed epidemi of considerable intensity occurred in West Virginia. For the purposes of this study, however, the epidemic area may be considered t be that defined above.

Besides the epidemic in the Northeastern United States, there occurred in the summer of 1916 an epidemic of considerable proportion in the States of Minnesota, Wisconsin, and Michigan, with som spread to the surrounding territory. This epidemic began simultaneously with, if not before, the epidemic in New York City and doe not appear to have had any connection with it.

CONDITIONS AT THE BEGINNING OF THE EPIDEMIC.

At the time of the beginning of the epidemic in New York Cit there were no known areas of epidemic prevalence in the Northeastern States. For the first five months of 1916 not more than fou cases were reported in any one week from the cities of the entir territory, and the whole number reported to the Public Health Service from the cities of this area during that period was 40. Thi prevalence is not in excess of the usual endemic prevalence for th territory and gave no hint of any unusual liability to the development of epidemic conditions.

The epidemic in New York City, described in detail in another par of this report, began on May 8, and cases did not begin to appear in any number outside the city until the first week in June, when cases occurred in Hudson, N. Y., a city of 12,500 persons situated on the Hudson River 115 miles north of New York City and connected with it by the main line of the New York Central Railroad, as well as by several lines of river steamers. It is unfortunate that no information is available to the writers as to the relation between the early cases in Hudson and the outbreak in Brooklyn. The epidemic in Hudson began so soon after that in Brooklyn as to arouse the suspicion that both outbreaks may have arisen from a common source.

In addition to the June cases in Hudson, an interesting group of cases appeared during June in Westfield, Mass. Careful investigation of these cases failed to show any connection with the cases in New York City, and the epidemic apparently ran an independent course. The neighboring cities of Springfield, Holyoke, and Chicopee in Massachusetts were apparently influenced but little, if at all, by the Westfield outbreak.

In addition to these cases in Westfield and Hudson, the other June cases in the epidemic area were widely scattered and comparatively few in number. The real epidemic outside of New York City began about July 1.

During the early weeks of July epidemic prevalence began in the northern part of New Jersey, in that portion of New York State immediately adjacent to New York City, and in that part of Connecticut lying nearest to the city. By the end of the month the epidemic was widespread.

During August the epidemic in New Jersey reached its crest and began to decline, while in the other States it did not begin to decline until September.

The location of cases in the States of the epidemic area, with the exception of Pennsylvania, is shown graphically by the accompanying series of maps, where may be plainly observed the extension of the disease outward from New York City. (Maps, appendix, V to EE.)

PREVALENCE BY STATES.

The number of cases by weeks for the various States included in the study are shown by the accompanying table and chart (Table S, appendix, chart No. 20), while the rates of incidence by States, by weeks, are shown by Table T (appendix) and chart No. 21. The incidence of the disease by States may be summarized as follows:

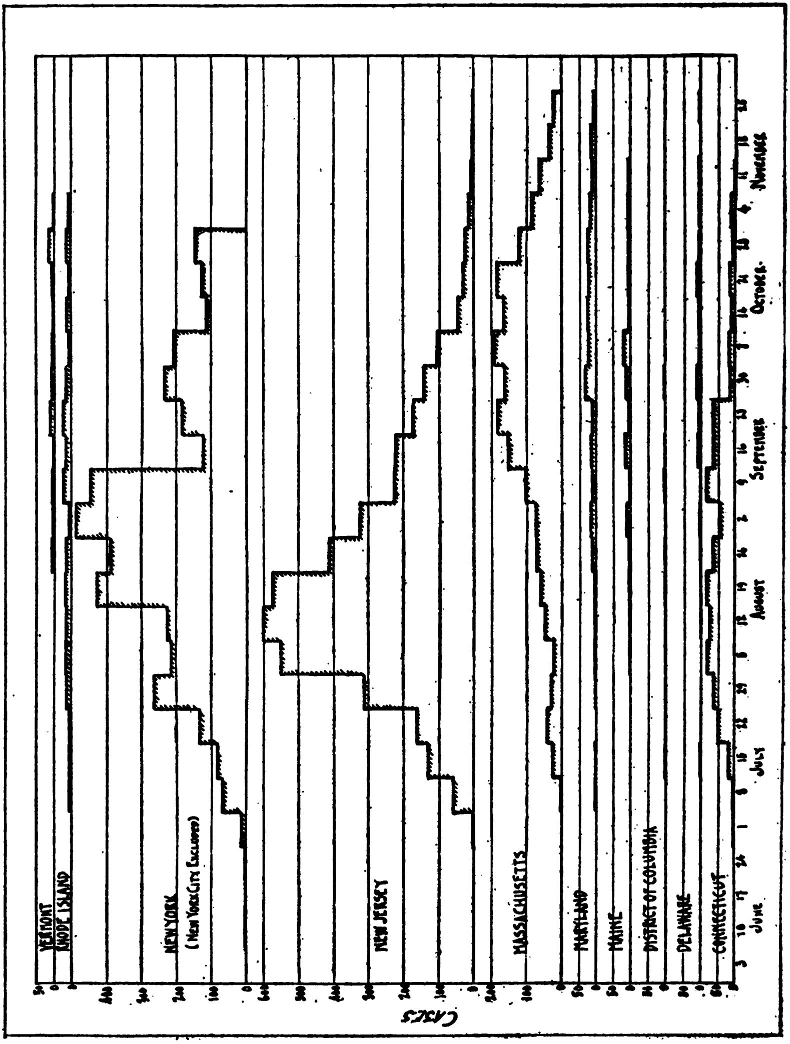


CHART No. 20.—Poliomyelitis, northeastern United States, 1916. Number of cases, by States, by weeks.

TABLE No. 81.—*Incidence of poliomyelitis by States, 1916.*

State.	Population.[1]	Cases.	Rate per 100,000.
New Jersey	2,844,310	4,164	146.4
New York[2]	4,640,543	3,885	83.5
Connecticut	1,223,583	856	70.0
Massachusetts	3,693,310	1,847	49.8
Rhode Island	602,765	222	36.8
Delaware	211,598	79	37.3
Maryland	1,351,941	250	18.5
Maine	767,638	128	16.7
Vermont	362,452	57	15.7
New Hampshire	440,584	51	13.8
District of Columbia	358,679	42	11.7

[1] Populations used in these studies are based on State censuses in Massachusetts, New York, and New Jersey for 1915, and United States census estimates for 1915 for the other States, counties being estimated by the standard method of the United States census.

[2] Exclusive of New York City.

As will be seen from the above table, in which the States are arranged roughly in accordance with their distance from New York

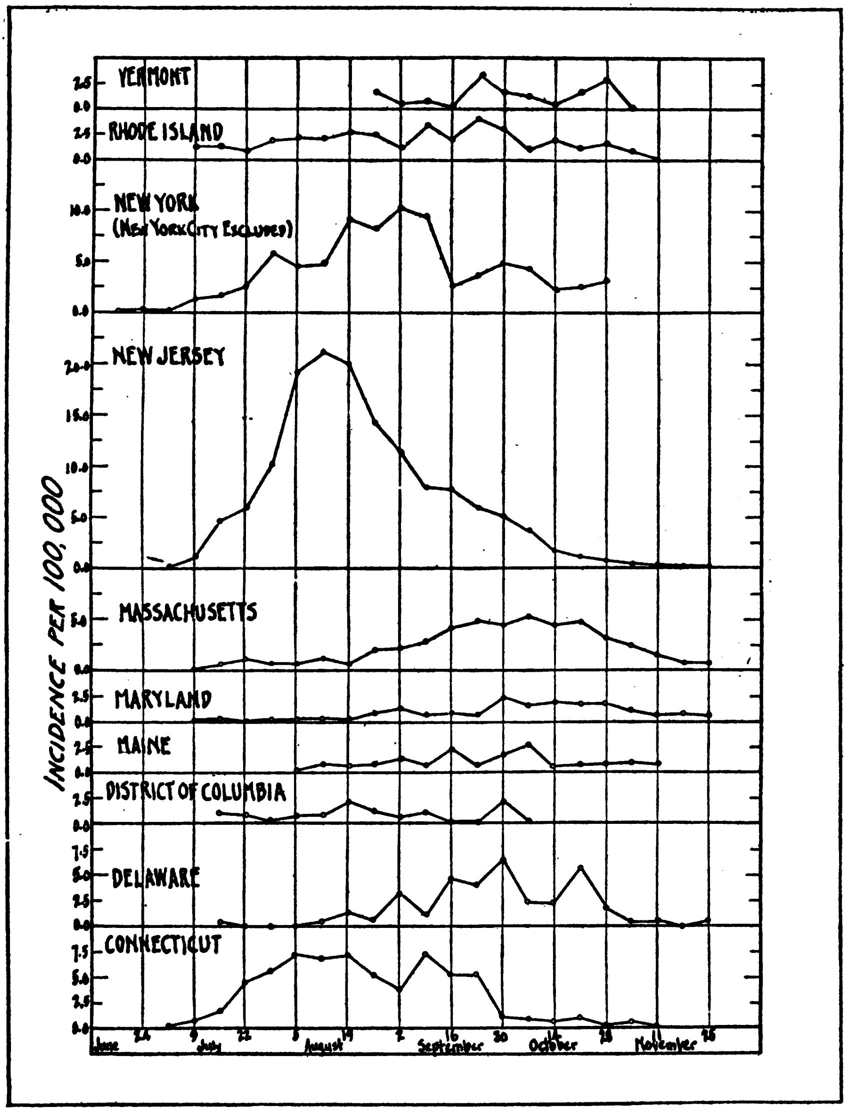


CHART No. 21.—Poliomyelitis, northeastern United States, 1916. Incidence per 100,000, by States, by weeks.

City, the rate of incidence decreases very strikingly with increasing distance from New York City.

PREVALENCE BY COUNTIES.[1]

The number of cases by weeks, by counties, for the States included in the study is shown by a series of tables. (Tables U to DD, appendix.) These tables show also the rate of incidence by counties, and this incidence is illustrated graphically by the map of the Northeastern United States, showing prevalence by counties. (Map BB, appendix.)

---

[1] See map EE, Appendix, an outline map showing counties and railroad lines.

This map shows very strikingly the high prevalence in certain counties near New York City and the very low prevalence in most counties at a distance from the city. The most interesting feature of the map, however, is the belt of counties of high prevalence extending across the middle of New York State, and the high prevalence in Grand Isle County, Vt., and Knox County, Me. A great deal of the territory in which these abnormally high rates occurred is much frequented by New York people during the summer months, particularly the Thousand Island and Lake Champlain regions. This may, in part at least, explain the high rates in these counties. Knox County, in which is situated the city of Rockland, Me., is connected with New York City by a direct boat line, and this region is also much frequented by New York people during the summer months.

PREVALENCE IN CITIES.

The rate of prevalence in cities of the territory under consideration is shown by the accompanying tables. Tables EE to KK (appendix) give the prevalence of poliomyelitis in all cities of 10,000 and over in the epidemic area (except in certain of the New England States, regarding which data are not available on this point) by weeks, with the total rate of incidence.

The rates of incidence in the various cities show wide variations, though in general the rates in any given section of a State tend to be rather uniform. The most striking exceptions to the general rule of prevalence are to be found in the cities of low prevalence, notably Jersey City, N. J., which, though situated between New York City and Newark, N. J., shows a rate of 63.7 against 340.1 for Newark; Albany, N. Y., with a rate of 1.9, against much higher rates in all surrounding cities; and Worcester, Mass., with a rate of 14.1 against 81.2 for Springfield, Mass., and 63.0 for Boston, Mass.

Strikingly high rates are shown by Oswego, Oneonta, Fulton, and Syracuse, in central New York, and by the cities immediately around Boston. The highest rate for a city of over 10,000 population is that of Irvington, N. J., with a rate of 473.4 per 100,000.

The general tendency to lower rates in cities, with increasing distance from the original focus of the epidemic, is shown by the following table, which gives the number of cities having various rates in groups, according to their distance from New York City.

Table No. 82.—*Variations in prevalence of poliomyelitis in cities of the northeastern United States arranged according to their distance form New York City.*

Distance from New York City.	Number and percentage of cities with specified rates per 100,000.										Total cities.
	Under 50.		50 to 100.		100 to 200.		200 to 300.		Over 300.		
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	
Under 50 miles	9	20.5	9	20.4	14	31.8	8	18.2	4	9.1	44
50 to 100 miles	11	47.8	7	30.4	3	10.0	1	4.4	1	4.4	23
100 to 150 miles	10	41.7	8	33.3	4	16.7	2	8.3	0	0.0	24
150 to 200 miles	52	72.2	14	19.5	6	8.3	0	0.0	0	0.0	72
200 to 250 miles	6	62.0	2	20.0	0	0.0	2	20.0	0	0.0	10
Over 250 miles	13	84.6	0	15.4	0	0.0	0	0.0	0	0.0	13

As will be seen from this table, the cities closest to New York constitute by far the larger percentage of those with higher rates. Only 9 of 44 cities under 50 miles from New York showed rates under 50, while all cities over 250 miles showed rates under 50 per 100,000. No city over 150 miles from New York showed a rate of over 300 per 100,000, and only two (Fulton and Oswego, N. Y., previously referred to) cities more than 200 miles away showed rates over 100 per 100,000.

It is quite evident, therefore, that the cities follow the general rule that the farther their situation from New York City, the less was their liability to high rates of attack.

VARIATIONS IN ATTACK RATE ACCORDING TO THE SIZE OF CITIES.

The incidence of the disease in cities of different size has been studied, and in Table LL (appendix) is shown the number of cases, the population, and the rate of incidence per 100,000 of the disease in groups of cities of various sizes.

The term "metropolitan district" as used in this table, refers to the territory within 10 miles of the cities of New York, Boston, Providence, and Philadelphia, defined by the Census Bureau as the metropolitan district of the respective cities. The metropolitan district in the New Jersey figures includes that part of the New York metropolitan district which lies in New Jersey and in addition a small part of the State which is included in the Philadelphia metropolitan district.

This table may be summarized as follows:

TABLE No. 83.—*Rates of incidence of poliomyelitis in metropolitan districts and in cities of various size.*

Rate per 100,000 for group:	
Metropolitan districts	154.2
Cities of 100,000 population and over	39.0
Cities of 50,000 to 100,000 population	38.9
Cities of 25,000 to 50,000 population	60.8
Cities of 10,000 to 25,000 population	78.7
Cities of under 10,000 population and rural districts	91.2

As will be seen from this table, leaving the metropolitan districts out of consideration, since they are overbalanced by the very high rates of New York City and the New York metropolitan district, the rate of incidence increases quite markedly with decreasing size of cities, the smaller cities having the highest rates, and the group of cities under 10,000 in population, including the rural districts, having the highest rates of all, more than twice as high as the cities of 100,000 and over.

It is unfortunate that owing to the peculiar governmental system of the States included in this study it is not possible to separate truly rural cases from those in the smaller cities. The New England town includes a village or city of indefinite size, surrounded by a greater or less extent of territory essentially rural in character. Since both reports of cases and statements of population are for the town as a whole it is not possible to separate accurately the rural cases from those occurring in the smaller towns. For this reason the towns below 10,000 in population, including the rural districts surrounding them, have been put into a single class.

SPREAD OF POLIOMYELITIS, BY ZONES, FROM NEW YORK CITY.

The studies of incidence of poliomyelitis by States already presented would seem to indicate that the wavelike spread, demonstrated by the studies in New York City, is characteristic also of the spread of the disease in the surrounding States. Accordingly zone studies have been made for the entire epidemic area, dividing the territory into concentric zones, described by circles of 50, 100, 150, 200, and 250 miles in radius, respectively, and tabulating the cases by weeks within each of the zones. In these zones the county has been taken as a unit, counting all of it within a zone when more than half is actually included.

Table MM (appendix) gives the results of this method of tabulation, while the list of counties following the table gives the counties included in each of the zones. The number of cases included in each zone, the population, the rate of incidence, and the crest of the epidemic, as indicated by the date of occurrence of the middle case of the epidemic (the date before and after which the same number of cases occurred), may be summarized as follows:

TABLE NO. 84.—*Incidence of poliomyelitis, by zones, northwestern United States 1916.*

[50-mile zones, with Brooklyn as a center.]

Zones.	Distance from Brooklyn, in miles.	Population	Cases.	Rate per 100,000.	Date of middle case.
I	Under 50	3,296,677	5,820	176.5	Aug. 17
II	50 to 100	1,417,160	1,296	91.5	Aug. 22
III	100 to 150	1,591,880	1,054	66.2	Sept. 12
IV	150 to 200	5,897,338	2,591	43.9	Sept. 27
V	200 to 250	1,328,415	384	28.9	Sept. 11
VI	Over 250	2,521,808	385	15.3	Sept. 14

[1] Exclusive of New York City.

As will be seen from the above, the disease exhibits strikingly the characteristics of wavelike spread seen in its dissemination through New York City. The decreasing incidence with added distance from New York City is quite regular, while the delay in the date of the middle case, or crest, is quite regular until the last two zones are reached.

In view of the fact that travel out of New York is directed into three main routes, separated from each other by natural barriers, the zones have been separated into three divisions, corresponding to these three main routes. Division I includes the States of Connecticut, Rhode Island, Massachusetts, Maine, Vermont, and New Hampshire, served by the New York, New Haven & Hartford Railroad, leading out of New York City to the north and northeast as well as by some lines of steamships. It is separated from division II by the Berkshire Mountains.

Division II includes the State of New York, served by the New York Central Railroad. Part of this territory is served by roads of secondary importance, leading to the northwest through New Jersey and Pennsylvania, but owing to the absence of statistical information regarding the State of Pennsylvania, the spread along this line can not be followed in detail, and this territory has been included with the remainder of New York State, served exclusively by the lines of railroad running up the Hudson River Valley.

Division III includes the States of New Jersey, Delaware, and Maryland, and the District of Columbia. It is served by the main trunk lines running to the south from New York City.

The cases, rates, and dates of occurrence of the middle cases for these divisions for the various zones are shown in detail in the accompanying Table NN (appendix). They may be summarized as follows:

TABLE NO. 85.—*Incidence of poliomyelitis by zones around New York City.*

[Divided according to the main lines of travel out of New York.]

[Rates are per 100,000 population.]

Zones.	Division I—Northeast.		Division II—North and northwest.		Division III—South.	
	Rate of incidence.	Date of middle case.	Rate of incidence.	Date of middle case.	Rate of incidence.	Date of middle case.
I	89.4	Aug. 16	251.5	Aug. 18	163.6	Aug. 14
II	64.7	Aug. 27	240.9	Aug. 15	64.9	Aug. 27
III	85.0	Sept. 13	45.1	Aug. 24	63.2	Sept. 17
IV	41.7	Sept. 29	75.7	Sept. 3	22.5	Sept. 29
V	15.6	Sept. 23	54.9	Sept. 18	9.5	Sept. 12
VI	16.3	Sept. 27	14.6	Aug. 28	....	....

As will be seen from this summary, the progress of the epidemic along these main lines of travel shows in general the characteristics displayed by the tabulation of the zones as a whole, though with somewhat greater irregularity, as would be expected from the smaller units under consideration. The early incidence in zone II, division II, is in part due to the epidemic in Hudson which came much earlier than that in the neighborhood. With this exception, the chronology is quite regular until the marginal zones with low rates are reached, when in all zones the chronology becomes irregular. The high rates in zone IV, division II, are due to the high rates previously referred to in the counties in central New York.

SPREAD OF THE DISEASE IN SMALLER UNITS OF POPULATION.

In addition to the general studies of the mass movement of poliomyelitis, made by means of the zonal tabulations already discussed, it has seemed desirable to make somewhat more detailed studies of the spread of the disease in more limited areas. For these studies advantage has been taken of some of the material collected in the intensive study which was made of the cases occurring in Hartford County, Conn., and Hunterdon, Warren, Sussex, and Middlesex Counties, N. J. These counties were selected for intensive studies by reason of the fact that they were conveniently located, of suitable size, of variable distance from New York City, and seemed to offer favorable conditions for the studies contemplated. The results of these intensive studies are given in another part of this report, and our purpose here is to consider only the chronological and geographical relationships of the cases.

HARTFORD COUNTY, CONN.

Hartford County is situated in the north-central part of Connecticut, its northern boundary forming part of the State line. The county is almost bisected by the Connecticut River, which traverses it from north to south, a little to the east of the center line.

Traffic from New York City enters Hartford County at the southern border over the New York, New Haven & Hartford Railroad, and also by a boat line from New York City to Hartford. The railroad line is the main route of the New Haven Railroad to Springfield, Mass., and points farther north, and also to Boston by way of Springfield. This main line has numerous branches in the county.

POLIOMYELITIS IN HARTFORD COUNTY.

The epidemic in Hartford County began about July 1, and the last case occurred about November 10. During that period there occurred 195 cases of the disease, which, with an estimated population of 277,879, gives a rate of 70.2 per 100,000.

These cases occurred, by months, as follows:

	Cases.
July	18
August	71
September	81
October	20
November	5
Total	195

The outbreak in Hartford County was quite regular in its chronological relation to the occurrence of cases in counties nearer to and farther from New York City, along the main line of travel. Northward from New York City the date of occurrence of the middle case[1] in the various successive counties along this line came as follows:

Week during which middle case occurred:

Fairfield County, Conn	Aug. 19
New Haven County, Conn	12
Hartford County, Conn	Sept. 2
Hampden County, Mass	23

The same regular progression of the epidemic along this line is even more strikingly shown by the date of occurrence of the middle case in the larger cities along the main line of travel. These are in order, northward from New York City, as follows:

Week during which middle case occurred:

Bridgeport, Fairfield County, Conn	Aug. 5
New Haven, New Haven County, Conn	12

---

[1] See section on New York City for definition of "middle case."

Week during which middle case occurred—Continued.

Wallingford and Meriden, New Haven County, Conn	Sept. 2
Hartford, Hartford County, Conn	9
Springfield, Hampden County, Mass	16
Chicopee and Holyoke, Hampden County, Mass	30

The chronology of cases in the various minor civil divisions of the county, with populations estimated for 1915 and the rate of incidence per 100,000, is shown by Table 00 (appendix).

As will be seen from this table, cases were reported from 24 of the 29 towns of the county. During July cases were reported from 6 towns. In August cases were reported from 20 towns, of which 16 had not previously had cases. In September cases were reported from 18 towns, of which all but 3 had previously had cases. In October cases were reported from 5 towns and in November from 2 towns, all of which had previously had cases.

The time of appearance of cases of the disease in various parts of the county is of great interest. The accompanying series of outline maps show the location of cases for July, August, September, and October. (Map. No. 13.) The presence of infection in the town during the previous month is shown by a solid dot. Other cases are shown by small circles.

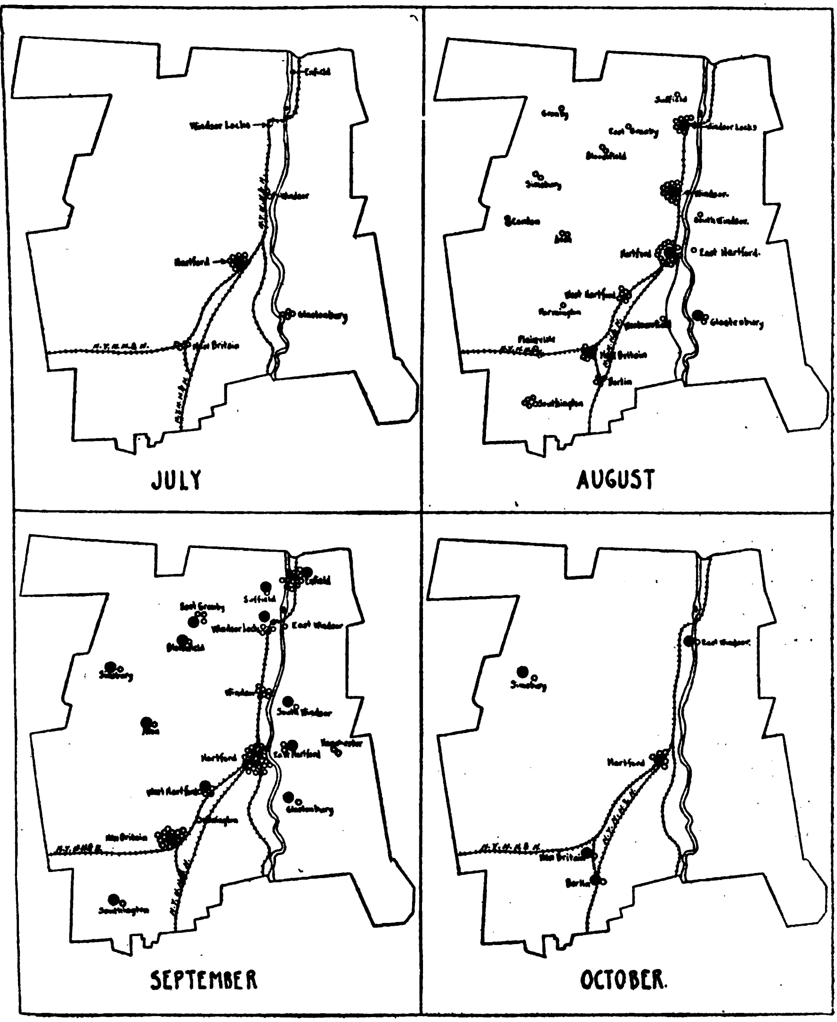
CASES IN JULY.

The first case in the county appeared during the first week of July, in Hartford City. During the month cases occurred in six towns, all of which, with one exception, are located on the main line of the New York, New Haven & Hartford Railroad. The exception, however, Glastonbury, is located on the Connecticut River, and the boat direct from New York City touches there daily. This place is also connected by a trolley line with Hartford.

The date of occurrence of the first cases in these towns was as follows:

Hartford	July 1
New Britain	4
Glastonbury	12
Windsor	19
Windsor Locks	22
Enfield	31

Hartford and New Britain, the largest cities of the county, were first infected. The other towns are the largest along the line of railroad. The progress of the disease northward from the three localities first infected is quite regular in its chronology.



Map No. 13.—Poliomyelitis in Hartford County, Connecticut. Location of cases, by months, 1916.

Note.—Circle indicates one case during designated month; black dot indicates one or more cases in indicated locality during preceding month.

AUGUST CASES.

The first cases in the towns in which the infection appeared in August were as follows:

Farmington	Aug.	1
Weathersfield		1
Southington		2
West Hartford		4
South Windsor		4
Avon		6

Suffield	Aug. 6
Canton	8
Berlin	16
Simsbury	18
East Hartford	18
Granby	20
East Granby	21
Bloomfield	21
Plainville	23

As will be seen from this list and the map, the towns infected during the first part of the month were for the most part in the southern half of the county, while those infected in the latter part were for the most part in the northern half of the county. The grouping of cases is most striking with regard to Granby, East Granby, and Bloomfield, adjoining towns, in which the infection appeared almost simultaneously.

Of the five towns in which no cases occurred, two—Hartland and Marlboro—have no railroads, and all lie on the extreme edges of the county. Bristol, a city of 15,536 population, escaped entirely.

The tendency of the larger towns to first attack and of the smaller units of population to later attack is shown quite strikingly by the table of cases, by towns, previously referred to, in which the towns are arranged in the order of their size.

As would be expected from the small population units considered, the variations in incidence rates between these towns is quite large. The county as a whole, however, seems to present about the rate which, in these circumstances, might properly be expected when consideration is given to its distance from New York City.

SUMMARY FOR HARTFORD COUNTY.

The dissemination of poliomyelitis in Hartford County, therefore, demonstrates quite strikingly the relationship which appears to exist between the spread of the disease and the original focus of infection in New York City. Those places most directly connected with New York were first attacked, the disease apparently spreading from the larger cities in the county to the smaller towns. Towns on direct railroad lines seemed more liable to early attack, larger cities being as a rule the first to suffer.

MIDDLESEX COUNTY, N. J.

Middlesex County is situated in the northeastern part of New Jersey. The northeastern boundary of the county adjoins the Borough of Richmond (New York City) on the east and is separated from it by a narrow strip of water called the Arthur Kill. The county is divided into two parts by Raritan Bay and Raritan River. It has an area of 312 square miles and a population of 144,716 (1915).

The county is traversed from north to south by the main lines of the Pennsylvania and Central of New Jersey Railroads. It is on the direct line of travel from New York City to the South. The county is also traversed by numerous branch lines of railroad.

The first case of poliomyelitis occurred on June 28, and between that time and November 1, 186 cases occurred, giving a rate of 128.8 per 100,000.

The middle case of the epidemic in this county occurred on August 12, while the middle case for the zone in which the county lies came on August 16, and for that part of the zone included in the State of New Jersey came on August 14. (Cf. zonal studies.) It is apparent, therefore, that the spread of the epidemic in the county was quite regular in its relation to that of the epidemic as a whole.

The chronolgy of the epidemic in the various cities, towns, and boroughs is shown in Table PP (appendix), which gives the number of cases, by weeks, for the various minor civil divisions, with populations and rates per 100,000.

During the epidemic cases occurred in 22 of the 23 civil divisions of the county.

In July 45 cases were reported from 12 cities, towns, and boroughs, of which only 1 had previously had a case.

In August 101 cases were reported from 17 cities, towns, and boroughs, of which 8 had not previously had cases.

In September 35 cases were reported from 10 cities, towns, and boroughs, of which only 1 had not previously had cases.

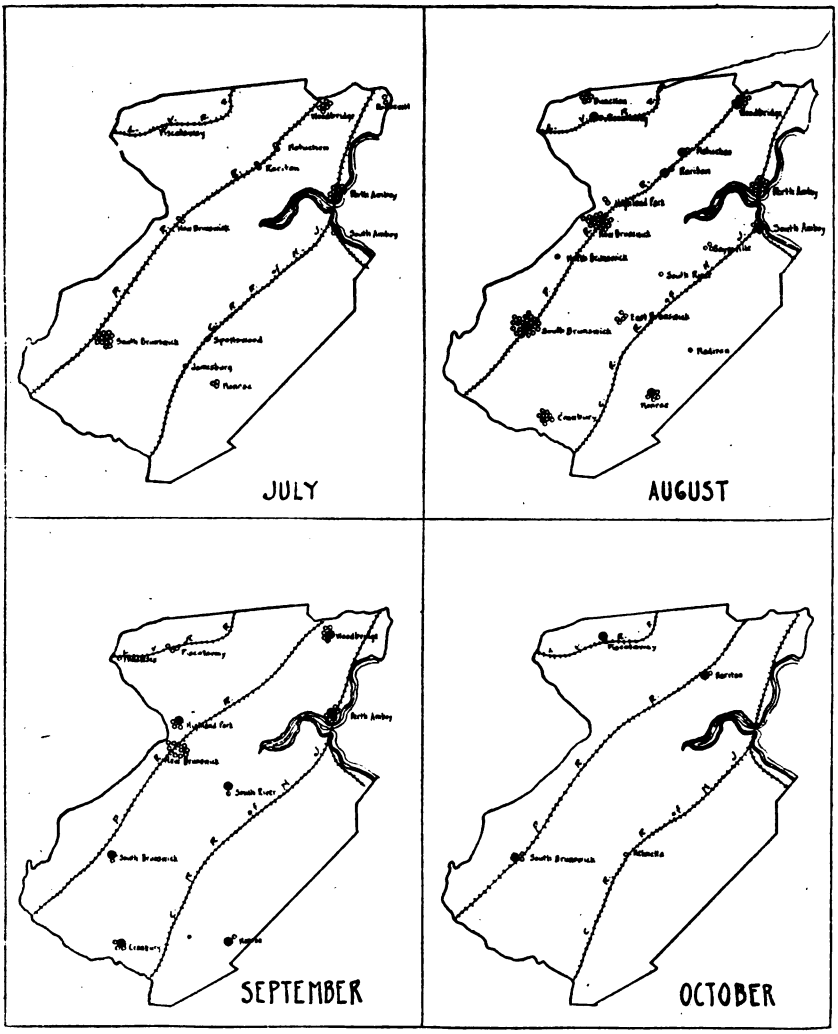
In October 5 cases were reported from 4 cities, towns, and boroughs, of which 1 had not previously had a case.

The week in which the first case occurred for the various cities, towns, and boroughs, was as follows:

Week ending—	
July 1.	New Brunswick city.
July 8.	Perth Amboy city.
	Woodbridge Township.
	Roosevelt Borough.
July 15.	Metuchen Borough.
	Spottswood Borough.
	Raritan Township.
	South Amboy city.
	Monroe Township.
July 22.	Piscatowney Township.
	South Brunswick Township.
Aug. 5.	Cranbury Township.
	Dunellen Borough.
	Jamesburg Borough.
Aug. 12.	East Brunswick Township.
	Highland Park Borough.
	Madison Township.
	Sayreville Township.
	South River Borough.
Aug. 19.	North Brunswick Township.
Sept. 9.	Middlesex Borough.
Oct. 14.	Helmetta Borough.

The location of these cases is shown by months in the series of maps (No. 14). As will be seen the first cases were in the larger cities of the county, especially those lying close to New York City.

Of the 12 towns in which the disease appeared prior to the end of July, 8 were located on or north of the Raritan River, and only 4 in the southern half of the county. During August, on the contrary, the disease appeared in only 2 towns north of the Raritan River, 1 of which, Highland Park, is a residential suburb of New Brunswick. In the southern half of the county, however, 6 towns previously not infected showed cases in August. Only 2 towns were infected during September and October, 1 of which was in the northern and the other in the southern half of the county.



MAP No. 14.—Poliomyelitis in Middlesex County, New Jersey. Location of cases, by months, 1916.

NOTE.—Circle indicates one case during designated month; black dot indicates one or more cases in indicated locality during preceding month.

The tendency to later attack of the smaller civil divisions is shown quite strikingly by the table of cases by weeks, in which the cities, towns, and boroughs are arranged in the order of their populations. This is also shown by taking, at various times during the epidemic, the average populations of the civil divisions attacked. This average is obtained by dividing the total populations of the cities, towns, and boroughs attacked during any week by the number of such minor civil divisions. For the weeks of the epidemic in the county the average size of the communities attacked was as follows:

TABLE No. 86.—*Population of communities attacked.*

Week ending—	Number of cities, towns and boroughs.	Combined populations.	Average population of group.
July 1	1	30,019	30,019
8	3	59,901	19,969
15	5	16,850	3,370
22	2	6,553	3,276
Aug. 5	3	6,275	2,092
12	5	19,892	3,978
19	1	1,247	1,247
Sept. 9	1	1,310	1,310
16	1	767	767

SUMMARY FOR MIDDLESEX COUNTY.

On the whole, therefore, it will be seen from this study of the dissemination of poliomyelitis in Middlesex County that the general character of the spread was quite similar to that observed in Hartford County, Conn. By reason of the fact that the entire county lies in such close communication with New York City the relationship to main lines of travel is not so evident. The tendency to first attack of the larger communities, and those lying nearest to New York City, however, is quite marked, the smaller communities and those lying farthest from New York City coming distinctly later than the others. The very high rates in South Brunswick and Cranbury Townships are also of interest. South Brunswick shows a rate of 1,331, and Cranbury a rate of 783 per 100,000.

HUNTERDON, SUSSEX, AND WARREN COUNTIES, N. J.

The conditions in these three counties are so similar that it seemed advisable to treat them together. They lie in the extreme northwestern part of the State, and their western boundaries, lying along the Delaware River, form the northern half of the western State line. The three counties have populations and areas, as follows:

TABLE No. 87.—*Population and area of the three counties.*

County.	Population.	Area in square miles.
Hunterdon	34,697	437
Sussex	25,977	529
Warren	44,314	362

These counties differ from the counties previously studied in that they lie entirely without the suburban or commutation area of New York City, and are largely rural in character. Phillipsburg, situated in the extreme western part of Warren County, with a population of 15,430, is the largest city of the three counties.

These counties are connected with New York City by five lines of railroad which traverse them from east to west or from northeast to southwest. None of these lines, however, is comparable, in amount of traffic, to those serving Hartford County, Conn., or Middlesex County, N. J.

Between the first week of November and the end of that month 87 cases of poliomyelitis occurred in the three counties, distributed, by months, as follows:

TABLE No. 88.—*Cases of poliomyelitis in the three counties.*

Month.	Cases by counties.			Total.
	Hunterdon.	Sussex.	Warren.	
July	14	3	....	17
August	23	7	4	34
September	8	4	7	19
October	6	4	6	16
November	....	1	....	1
	51	19	17	87

In its relation to the chronology of the epidemic as a whole, the area was quite regular. The middle case of the epidemic in the three counties as a whole came on August 26. The counties lie on the border between the 50 and 100 mile zones, in which the middle cases came on August 16 and 27, respectively. (Cf. zonal studies.)

The disease appeared first in Readington, Hunterdon County, located on the Central Railroad of New Jersey at the eastern edge of the county, nearest New York City. Of the 51 cases which occurred in this county, 40 were located along this line of railway. Twelve of the 14 July cases in Hunterdon were located in the eastern half of the county. The most striking fact in connection with the epidemic in Hunterdon County was the development of foci in each of the towns along the railroad referred to above, beginning with those nearest New York City. The rest of the county was infected very lightly. Although there are no large cities in the county, there is apparent some tendency to early attack of the larger communities as shown by the table of cases, by weeks, by minor civil divisions, Table QQ (appendix). Similar tables for Warren and Susex counties are RR and SS (appendix).

Warren County showed no cases in July and only 4 in August, all on main line railroads. Eleven of the 17 cases which occurred in the county were in Hackettstown, the third largest city in the county, located on the main line of railroad from New York City. This outbreak is of special interest by reason of the fact that the whole of the 11 cases occurred during September and within a period of two weeks.

Philipsburg, the largest city in Warren County, did not report any cases, though two cases occurred in the suburban territory just outside the city.

The spread of the disease in Warren County, therefore, was characterized by low incidence and striking limitation to one small district.

In Sussex County the disease first appeared in the largest town in the county—Newton, with a population of 4,433. Nearly half the total cases in the county occurred in this town. The remaining cases were scattered and irregular in chronology. The accompanying series of outline maps show the location and chronology of the cases in the counties. (Map No. 15.)

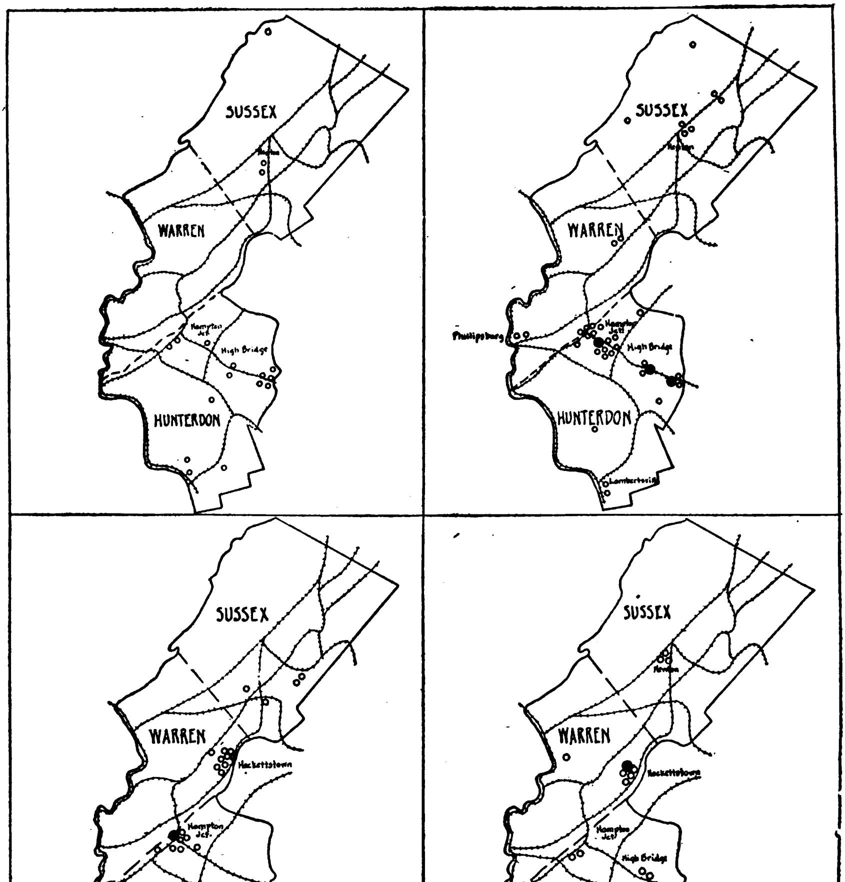
SUMMARY OF COUNTY STUDIES.

The general features of the spread of the disease as observed in the studies just discussed are quite regular. The communities of largest size, located on main lines of travel from New York, were first attacked. Smaller communities, farther from New York and not on main lines of travel, were usually attacked later, or altogether spared. The spread from city to city was usually quite regular as to chronology, and the spread from the larger cities to the smaller communities and rural districts immediately about them was equally regular. The relation of the spread of the disease to human travel is quite evident.

SUMMARY OF STUDIES OF INCIDENCE OF POLIOMYELITIS OUTSIDE OF NEW YORK CITY.

Summarizing the studies of the incidence of poliomyelitis outside of New York City, it may be said that the epidemic exhibited the characteristics of an epidemic wave, originating in Brooklyn and traveling outward in all directions, gradually diminishing in intensity of incidence with increasing distance from New York City.

The rates of incidence showed strikingly regular variations with increasing distance from New York City, whether taken by States, counties, or cities, though there occurred certain marked irregularities for which no explanation is apparent.



MAP NO. 15.—Poliomyelitis in Sussex, Warren, and Hunterdon Counties, New Jersey. Location of cases, by months, 1916, July–October.

NOTE.—Circle indicates one case during designated month; black dot indicates one or more cases in indicated locality during preceding month.

The rate of incidence varied somewhat with the size of the community. Leaving the metropolitan districts out of consideration, the rate of incidence was lowest in cities over 100,000 population, higher in cities between 10,000 and 100,000 population, and highest in cities under 10,000 population and rural districts.

Among the smaller units of population, those cities of largest size, situated on main lines of travel, were in general first attacked, the smaller cities, and those farther from main lines of travel, were attacked later.

The disease seemed to spread primarily from city to city. The smaller communities and rural districts were apparently infected from the nearest large group of population.

The influence of no factor of consequence other than the number and distribution of human population is discernible in the spread of the disease.

THE EXPORTATION OF CASES OF POLIOMYELITIS FROM NEW YORK CITY.

Following the announcement of the existence of an epidemic of poliomyelitis, which was made by the department of health of the city of New York about June 17, thousands of children were removed by their parents from the city, going to practically every part of the surrounding territory. This movement was in addition to the normally large movement of children from the city to the rural districts of Northeastern United States which takes place every summer.

It was apparent in the beginning of the investigation of the spread of poliomyelitis outside the city of New York that this movement offered an unusual opportunity for studying the effect of this exportation of possibly infected persons on the spread of the disease in the area about the city.

Arrangements were made accordingly to collect all information possible bearing on this point. In Massachusetts practically all of the cases occurring outside the largest cities were visited by the district medical officers of the State department of health, and full information was collected. In Connecticut and Rhode Island, through the cooperation of the State department of health, information regarding cases from New York City was obtained by the local health officers. In New Jersey partial information was so obtained. In the other States, however, no information bearing on this point was available. In addition to the information collected by the States, further information was furnished by the intensive studies made in Hartford County, Conn., and in parts of Hunterdon, Warren, Sussex, and Middlesex Counties, N. J., and by special studies in other parts of the epidemic area. The information collected in regard to the four States of Massachusetts, Connecticut, Rhode Island, and New Jersey is not believed to be absolutely complete, in that some cases in persons from New York City may have been omitted, but is believed to be substantially accurate as far as it goes. Included in the tabulations with cases in persons from the city of New York are a few cases in persons from Newark, N. J., and other heavily infected areas in the immediate vicinity of New York City.

CASES IN PERSONS FROM NEW YORK CITY.

Records were obtained of 99 persons from New York City and its immediate vicinity, who after leaving the city developed the disease. These were distributed as follows:

TABLE No. 89.—*Cases in persons leaving New York City.*

State.	Total cases.	Cases in persons from New York.	Per cent of total cases.
Massachusetts	1,815	21	1.2
Rhode Island	222	5	2.2
Connecticut	856	59	6.9
New Jersey	4,148	14	.3
Total	7,041	99	1.4

RELATION OF CASES FROM NEW YORK CITY TO EPIDEMICS IN OTHER PLACES.

Of the 99 cases which developed in persons from New York City, 63 occurred in cities in which the disease was already prevailing or in which the first local case occurred simultaneously with the case from New York City. In 36 towns or cities the first case was in a person from New York City. These were distributed as shown in the following table. This table gives the total number of towns in the four States in which cases occurred during the summer; also the percentage of these towns in which the first cases occurred in a person from New York City:

TABLE No. 90.—*Exportation of infection from New York City—Percentage of first cases in infected cities of four States apparently exported from New York City.*

State.	Number of cases in persons from New York City.	Number of these which were first cases in the city or town.	Total cities or towns having cases.	Percentage which first cases from New York City form of total first cases.
Massachusetts	21	10	156	6.4
Rhode Island	5	3	16	18.7
Connecticut	59	18	117	15.4
New Jersey	14	5	109	4.6
Total	99	36	398	9.1

TIME ELAPSING BETWEEN NEW YORK CASE AND FIRST LOCAL CASE.

In order to determine the influence of cases from New York City on the spread of the infection in the surrounding territory, and also to determine whether or not the subsequent cases could properly be ascribed to direct infection from the New York City cases, it is necessary to determine the time elapsing between the development of the case from New York City and the development of the first local case.

The time elapsing between the New York City cases and the local cases has been tabulated and is given as follows:

TABLE No. 91.—*Interval between development of case from New York and development of first local case.*

Interval between New York case and first local case:	Cases.
0	2
1 day	1
2 days	2
3 days	1
4 days	2
5 days	2
6 days	3
7 days	3
8 days	1
9 days	1
10 days	1
11 days	0
12 days	1
13 days	1
14 days	2
15 days	0
16 days	1
17 days	1
18 days	0
19 days	1
20 to 30 days	2
30 to 40 days	1
40 to 50 days	0
50 to 60 days	1
60 days and over	1
Total	31
Local cases	5
All New York cases	36

From the above table it will be seen that there is no striking relation between the time of development of the case from New York city and the development of local cases. The interval varied from 0 to 60 days, and in 5 cases no subsequent cases developed locally, but approximately one-half occurred with 10 days.

PERIOD ELAPSING BETWEEN DEPARTURE FROM NEW YORK CITY AND DEVELOPMENT OF POLIOMYELITIS.

Of the 99 cases of poliomyelitis which developed in persons leaving New York City, obviously not all were contracted in the city. In spite of this fact, however, it was thought that a study of the time of development of the disease in these persons, in relation to the time of leaving the epidemic area, might throw important light on the incubation period of the disease. In 33 of the 99 cases the time of leaving New York was not ascertained, thus leaving 66 cases available for study. The time elapsing between the departure from New

York city and the development of the disease in these 66 cases is shown in the following table:

TABLE No. 92.—*Time of development of poliomyelitis in persons leaving New York City.*

Interval between departure from New York City and onset:	Cases.
Same day	4
1 day	4
2 days	2
3 days	7
4 days	1
5 days	2
6 days	4
7 days	6
8 days	1
9 days	2
10 days	1
11 days	0
12 days	2
13 days	0
14 days	5
15 days	2
16 days	--
17 days	1
18 days	2
19 days	1
20 to 29 days	7
30 to 39 days	6
40 days and over	6
All cases	66

As will be seen from the above table, the time of development of the disease after leaving New York is quite irregular, the only notable feature being the fact that about half of the cases developed within seven days of the time of departure.

As this classification includes many cases which were probably infected in the community where the disease developed, rather than in New York City itself, a separate classification has been made of the 36 cases which developed in persons who left New York City and who were the first cases in the communities where they did develop. These include, therefore, only those cases who were presumably infected prior to leaving New York City, or infected subsequently as a result of specially intimate contact with the city. The time of leaving New York was not ascertained in eight of these 36 cases, leaving 28 cases available for study. The development of these cases was as follows:

TABLE No. 93.—*Development of cases of poliomyelitis in persons from New York City, who developed the disease in communities apparently free from infection.*

Interval between departure from New York City and onset:	Cases.
Same day	2
1 day	4
2 days	2
3 days	4
4 days	0
5 days	2
6 days	4
7 days	5
8 days	0
9 days	1
10 days	0
11 days	0
12 days	1
13 days	0
14 days	0
15 days	1
16 days	0
17 days	0
18 days	1
19 days	0
20 days	0
30 days	1
All cases	28

It is quite striking that 23 of the 28 cases developed within seven days after leaving New York City.

While this evidence can not be considered as conclusive, yet it indicates strongly that the period of incubation of poliomyelitis is under seven days. The number of cases is not large, but the circumstances are such as to give strong weight to the presumption that the cases were infected prior to leaving New York City. They constitute, therefore, a somewhat unique series. (See pp. 129–130.)

SUMMARY OF EXPORTATION OF CASES.

In general, the foregoing study does not show that the cases actually in persons from New York City were a very large factor in the spread of the epidemic, since such cases were the first known source of infection in only 9 per cent of the infected towns, and constituted only 1.4 per cent of the total cases which occurred in the States included.

The time of development of cases in persons going out from New York City is quite irregular, but if only those cases are considered which were probably infected prior to leaving the city, it is seen that in a large proportion of them the disease developed quite definitely before the end of the seventh day after their departure.

AGE DISTRIBUTION.

For the studies of age distribution there are available the cases occurring in Massachusetts, Connecticut, Rhode Island, and New Jersey with the exception of the city of Newark, N. J. The group comprises 5,688 cases, as follows:

Massachusetts	[1] 1,836
Rhode Island	222
Connecticut	856
New Jersey	2,774
Total	5,688

Of the 5,688 cases the age of 125 cases is not given, leaving 5,563 cases of known age available for study. The age distribution of these cases is given by States, by single years under 20, and by 10-year periods above 20 in Table T T (appendix). In Table U U (appendix) is given the number and percentage of cases in standard age periods.

In general, the age distribution of the cases is similar to that observed in previous epidemics and in the New York City epidemic of 1916. The following table gives the comparative distribution of the cases in New York City and in the territory outside:

---

[1] Eleven cases included in table of incidence by counties omitted from this table; information incomplete.

TABLE No. 94.—*Age distribution of cases of poliomyelitis in New York City and in the States outside.*

Age-group years.	Percentage of total cases in each age group.	
	New York City.	States outside.
Under 1	11.1	8.6
Total under 5	79.2	68.1
5 to 9	16.2	20.9
10 to 14	2.5	5.0
15 to 19	.9	2.4
20 and over	1.2	3.6
	100.0	100.0

As will be seen from this table, the age distribution of the two groups of cases differs in the larger percentage of cases in the higher age groups, shown in the territory outside of New York City. The cases outside of New York City have been classified according to the place of their occurrence. All cases occurring in the metropolitan districts of New York City, Boston, Philadelphia, and Providence have been grouped together; all cases occurring in cities of over 100,000 population in a second group; those in cities of 50,000 to 100,000 population in a third; those in cities of 25,000 to 50,000 population in a fourth; those in cities of 10,000 to 25,000 population in a fifth; and the sixth group includes all cases occurring in cities of less than 10,000 population, and in the rural districts.

The results of this tabulation are given in Table VV (appendix), which shows the number of cases in each group by single years under 20, and by ten-year periods above 20. Table WW (appendix) shows the number and percentage of cases in each group for the standard age periods.

In view of the fact that many previous studies of the age distribution of poliomyelitis have been based on an age distribution different from the standard periods, comprising a group under 1, 1 to 5, 6 to 10, etc., the cases have been tabulated also according to this distribution, and the results are given in Table XX (appendix).

The age distribution of the cases of 1916 in the various groups of cities outside of New York City may be compared with that of other urban and rural outbreaks, using the age distribution groups previously used. This is done in Table YY (appendix).

As will be seen from this table, the age distribution of cases in the metropolitan districts outside of New York City approached that of previous urban epidemics, while the age distribution for the smaller cities and for the rural districts tended to the characteristic increase in the attack of the higher age groups so characteristic of rural epidemics in general. The smaller cities tended to approach the rural conditions, while the larger cities more clearly approximated those of the metropolitan districts.

In general, therefore, the cases occurring outside of New York City during 1916 were characteristic in age distribution, and confirm the observations previously made by Frost that the percentage of cases in the higher age groups is constantly higher in rural than in urban outbreaks.

B. INTENSIVE EPIDEMIOLOGIC STUDIES OUTSIDE OF NEW YORK CITY, 1916.

INTRODUCTION.

The scope and purpose of these studies have already been explained. It may be added further, however, that in all of the studies outside of New York City special attention was devoted to the question of contact, and effort was made constantly to discover any relation of this character which might be fairly established with the original focus in New York City itself. In the selection of places for investigation transportation relations with New York City were kept in mind.

The data upon which the studies are based were collected in cooperation with local health authorities, through a personal canvass made by officers of the Public Health Service. Use was made of the same case card shown in the Richmond Borough study, and the methods employed did not differ materially from those already described.

In contrast with New York City these cases for the most part occurred in small cities or among rural populations. They are divided roughly into the following groups: Cases in New Jersey, cases in Hartford County, Conn., and miscellaneous cases in Bridgeport and other places in Connecticut and in Rhode Island.

The presentation of these studies follows in a general way that of Richmond Borough, since the studies were of a similar character and the results in general are on a comparable basis. There is, however, a difference. In Richmond Borough one entire section of territory was completely studied in detail. In these studies, as already explained, it was not possible or desirable to make such a complete study as this of any one section of territory. A sufficient number of cases were studied, however, in several places to give an adequate idea of the behavior of the epidemic in its detailed as opposed to its general features.

In the presentation of the results, where nothing is gained by separation, in order to avoid useless repetition the data are presented in a combined form. In some cases, where it seemed advisable to do so, the data of the Richmond Borough studies have been combined with these studies. Where this is done it is clearly indicated and reasons given for such combinations.

The reader is referred to the preceding pages for a discussion of such matters as distribution of population, origin and general course of the epidemic, geographic distribution of cases, incidence rates, etc. Mention is made in this section only of data not previously presented in the general study.

DESCRIPTION OF TERRITORY INVOLVED.

In the general study presented in the first part of this section the geographical positions and transportation relations of the territory involved in these studies have already been given. Along with this, also, rather full statements have been made concerning populations, areas, and densities of populations in the same territory. Some further details concerning other features remain to be briefly stated.

At the outset it may be said that the selection of the various places soon to be mentioned for studies of this character was based on a variety of considerations. Chief among these, however, were the situation of these places with reference to New York City, the environment in which the cases occurred, and the development of the epidemic.

NEW JERSEY.

In this State cases were investigated in (1) that part of Middlesex County lying south of the Raritan River exclusive of Sayreville Township and the city of New Brunswick, (2) the cities of New Brunswick and Highland Park, and (3) the counties of Hunterdon, Warren, and Sussex.

These latter counties comprise the northwestern part of the State, while Middlesex, which contains New Brunswick and Highland Park, is situated more centrally on the northeastern side of the State.

The western part of Warren and Sussex Counties lie in the Appalachian Valley. Their eastern parts, as well as northern Hunterdon, are mountainous with elevations from 800 to 1,200 feet. Southern Hunterdon and northern Middlesex Counties form a part of the Piedmont Plateau. The rest of Middlesex belongs to the Coastal Plain.

Neither Hunterdon, Warren, nor Sussex Counties are densely populated, nor do they contain any cities of appreciable size. Hunterdon is a fairly fertile farming section with the average rural type of population. Warren and Sussex, being more mountainous, are less given to farming. Considerable territory is devoted to cattle grazing.

The economic status of the population seems hardly equal to that of Hunterdon County.

Taking these three counties as a whole, probably 90 per cent of the houses are of frame construction. Half of them are in poor repair, 40 per cent in fair condition, and 10 per cent are of the better class, in good condition. Practically all of the rural houses have surface privies in poor sanitary condition. Isolation of cases of poliomyelitis, while attempted, was poorly performed.

Middlesex County is also a farming section. There is a considerable foreign element in the population. There are numerous villages, most of which are small, and the general sanitary conditions are poor. In South Brunswick Township quite a number of Italians are employed as track laborers on the Pennsylvania Railroad. At Monmouth Junction there are huge collections of stable manure shipped from New York City. Four large piles of this manure (each about 1,000 feet in length) are found on a spur of the railroad some one-fourth of a mile west of the village of Monmouth Junction.

The city of New Brunswick, located on the south bank of the Raritan River, is a place of some importance, with a population of 30,019 (1915); Highland Park is a small residential suburb just across the river. New Brunswick is a busy place with several large schools and numerous large manufacturing plants. General sanitary conditions in New Brunswick are as good as the average for a place of equal size, similarly located.

HARTFORD COUNTY, CONN.

This county, located in the north central portion of the State, is divided from north to south by the Connecticut River. Topographically, therefore, the county is a large valley or river bottom. To the west the land rises into a range of hills some 400 feet in height, while to the east there is also a rise, but only to an elevation of some 100 or more feet.

The county is well populated and possesses numerous villages and towns as well as one or two large cities. There is also a large agricultural development, the chief crop being tobacco. In the cities there exist numerous manufacturing plants of various kinds.

The economic status of the laboring classes, both rural and urban, is good. General sanitary conditions, both rural and urban, are as good as the average. The typhoid mortality rate, while high, is steadily declining. There is a considerable foreign element in the population. There is also annually a large importation of laborers for the care and harvesting of the tobacco crop. These have been largely Italians, though negroes from the South were used extensively in 1916. The number of laborers imported in 1916 has been estimated at 10,000.

OTHER TERRITORY.

The investigations in New Jersey and in Hartford County were very much more complete than the other intensive studies made outside New York City. That is to say, investigation was made of a much larger percentage of the total cases occurring in these places than elsewhere. Indeed the rest of the cases investigated were scattered in various places in Connecticut and Rhode Island. The purpose in these latter studies, as already explained, was largely an investigation of cases on the advancing fringe of the epidemic in order to determine their connection with New York City. So much territory was covered in these cases, and the investigation was so incomplete in regard to the total number of cases which occurred, that any description of the territory involved seems unnecessary.

The following is a summary of the cases investigated:

TABLE No. 95.—*Summary of cases investigated outside of New York City.*

	Paralytic.	Abortive.	Suspicious.	Total.
Group I. Middlesex County, N. J., cases	50	4	6	60
Group II. New Brunswick and Highland Park, N. J., cases	28	2	....	30
Group III. Hunterdon, Warren, and Sussex County, N. J., cases	44	9	3	56
Hartford County, Conn., cases	92	11	14	117
Bridgeport, Conn., cases	33	2	2	37
Miscellaneous Connecticut and Rhode Island cases	89	3	9	101
Total	336	31	34	401

Total deaths		92
Case fatality rate (all cases)	por cent	22.9
Case fatality rate (excluding suspicious)	do	25.1
Males (all cases)		220
Females (all cases)		181
Males (excluding suspicious)		200
Females (excluding suspicious)		168

RELATIONS TO ENVIRONMENTAL CONDITIONS.

The environment under which the disease occurred was investigated in practically all the cases studied. The results of this investigation are given in two combined tables. One table covers the New Jersey and Hartford County cases and the other the miscellaneous cases. The cases are separated in two tables because the data collected in one instance differs somewhat from those collected in another. The chief difference in these tables lies in the fact that in New Jersey and Hartford County consideration was given to the possible influence of rat infestation in relation to the spread of the disease. It has been suggested by Richardson, and perhaps others, that rats may be looked upon as possible disseminators of poliomyelitis. Our investigations from an epidemiological standpoint do not tend to support this suggestion. Very naturally evidences of rat infestation were common. On the other hand, an appreciable percentage of cases (about one-fifth in this series) were found to occur under conditions where there was no indication of rat infestation. Such evidence as this does not, of course, possess sufficient value to determine the question, but is at least quite suggestive.

As for general sanitary conditions shown by these tables, it may be said that the cases occurred under the usual sanitary conditions which obtain in a similar environment. The conditions were certainly as good as the average and perhaps better, and this is the most striking thing shown. There is nothing to suggest that the spread of the disease bears any special relation to the sanitary conditions under which it occurred.

TABLE No. 96.—*Combined summary.*

[Environmental conditions of 263 cases (including suspicious), Hartford County, Conn., 117 cases, and New Jersey 146 cases.]

Population and environment:		
Rural—		
Good	11	
Fair	75	
Poor	10	
		96
Village—		
Good	11	
Fair	34	
Good	19	
		64
Urban—		
Good	51	
Fair	21	
Good	31	
		103
Grand total		263
CHARACTER OF RESIDENCE.		
Tenement	35	
Apartment	14	
Other residences	214	
		263
One-family houses	159	
More than one-family houses	104	
		263
Detached houses	194	
Semidetached houses	37	
No data	32	
		263
Yard present	245	
Yard absent	18	
		263
Construction:		
Brick	34	
Frame	225	
Stone	4	
		263

Age of residence:		
New	43	
Medium	85	
Old	135	
		263
State of repair:		
Good	103	
Fair	71	
Poor	89	
		263
Cellar present	193	
Cellar absent	25	
Both absent	26	
No data	19	
		263
Floors:		
Board	17	
Cement	74	
Earth	124	
No data	22	
No cellar or basement	26	
		263
Outbuildings:		
Present	190	
Absent	51	
No data	12	
		263
Sewage disposal:		
City sewer	89	
Cesspools	16	
Surface privy	100	
Vault privy	56	
No data	2	
		263
Animals on premises:		
Present	199	
Absent	63	
No data	1	
		263
General cleanliness of premises:		
Good	78	
Fair	89	
Poor	99	
No data	1	
		263
Insect on premises:		
House flies present	257	
House flies absent	5	
No data	1	
		263
Stomoxys present	217	
Stomoxys absent	45	
No data	1	
		263
Fleas present	105	
Fleas absent	157	
No data	1	
		263

Garbage disposal:		
City disposal	88	
On premises	158	
Buried or burned	16	
No data	1	
		263
Proximity of stables to dwellings:		
Within 100 yards of house	161	
Within 300 yards of house	57	
Over 300 yards away	15	
None in vicinity	22	
No data	8	
		263
Probability and evidence of rat infestation:		
Present	177	
Absent	51	
No data	15	
		263

TABLE No. 97.—***Summary of environmental conditions surrounding 127 cases (excluding suspicious), miscellaneous, Rhode Island and Bridgeport, Conn.***

Density of population:		
Dense	46	
Medium	28	
Sparse	53	
No data	0	
		127
General sanitation:		
Good	40	
Fair	35	
Poor	52	
No data	0	
		127

CHARACTER OF RESIDENCE.

NOTE.—" More than one family in house " includes all two or three family houses, as well as apartment houses and tenements, which have common entrance. " One family only " includes all houses detached, or otherwise, having private entrance. " Detached houses " are those having access to the open air on all four sides. " Semidetached houses " are those having access to the open air on two or three sides only.

More than one family in house	[1] 64	
One family only	[2] 50	
No data	13	
		127
Living in detached house	77	
Living in semidetached house	13	
No data	37	
		127

---

[1] Includes 3 cases in boarding houses.

[2] Includes 1 case in a girls' summer camp and 1 case in a boarding house.

Sewage disposal:		
Inside toilets with sewer connections or cesspool connections	76	
Outside (without sewer connections), including vaults and surface privies	51	
No data	0	
		127
Animals on premises:		
Domestic animals present on the premises	88	
Domestic animals absent from the premises	39	
No data	0	
		127
Proximity of stables:		
On premises	25	
Within 100 yards of house	38	
Between 100 yards and 300 yards away	26	
No stables near	38	
No data	0	
		127
Sanitary conditions on premises:		
Good	47	
Fair	30	
Poor	50	
No data	0	
		127

RELATIONS TO MILK SUPPLY.

So far as concerns foods which are consumed raw, investigation was made only of the milk supply. Information on this point was sought in all the cases studied outside of New York City. Reliable data were secured in a total of 379 cases studied in the various places already mentioned. The results are combined in the table below.

It will be observed from this table that 39 of the cases used no cow's milk and 109 obtained milk from their own private cows. The 218 cases which obtained milk from outside sources (dairies and stores) secured their supply from 136 different dealers. Of these dealers 98 had only 1 case among their customers, thus leaving only 38 dealers with more than 1 case, and 20 of these had only 2 cases among their customers. It is to be regretted that information is not available as to the daily quantity of milk sold by these 38 dealers. It is known that most of them are among the larger dealers, who sell, of course, to a large number of families. More exact information is not available. From the data presented, however, the inference may be fairly drawn that milk played no part of consequence in the spread of the disease. This same conclusion, it will be recalled, could be reached even more definitely in the cases studied in Richmond Borough.

In this connection it may be interesting to note that one town center in Connecticut, with a population of about 1,000, had 4 cases of poliomyelitis. There were three main sources of milk supply. There occurred in the families of two of those milk dealers cases of the disease—one in one family and two in the other. Outside of these two families there was only one other case of the disease in the population. The other case occurred in a family obtaining milk from one of the sources mentioned above, but the date of onset antedated the appearance of the disease in the family of the milk dealer.

TABLE No. 98.—*Combined summary of milk supply.*

Number of cases outside New York City concerning whom there was reliable data in regard to milk supply		379
Number using fresh cow's milk		340
Number using condensed milk	9	
Number using breast feeding only	13	
Number using no milk of any kind	17	
Number using no cow's milk		39
Cases obtaining fresh cow's milk:		
Cases obtaining milk from private cow	109	
Cases obtaining milk from grocery stores	9	
Cases obtaining milk from dairies	209	
Cases using fresh cow's milk, source unknown	16	
Total		343
Cases obtaining milk from 2 sources		3
Total cases using fresh cow's milk		340

Dealers supplying fresh cow's milk to cases:
2 dealers, each had 9 cases among his customers.
1 dealer had 6 cases among his customers.
2 dealers, each had 5 cases among his customers.
4 dealers, each had 4 cases among his customers.
9 dealers, each had 3 cases among his customers.
20 dealers, each had 2 cases among his customers.
98 dealers, each had 1 case among his customers.

RELATION TO OCCUPATION.

Just as in the Richmond Borough study, investigation was made concerning the occupations of all wage earners in families having cases of the disease. A careful study of these tabulations, with due consideration to local conditions, failed to show anything significant with regard to occupation.

Investigation was also made concerning the effect of association between persons engaged in the same occupation. This, of course, is not a question of occupation per se but rather one of general contact. The results of this investigation are presented in Table No. 99, which represents a combined summary of all the cases studied both within and without New York City. It is shown that in a total of 729 cases occurring in 612 families, there was some association more or less intimate between the wage earners of 183 of these families, whereas in the other 429 of them no association of this kind occurred.

TABLE No. 99.—*Combined summary showing association at places of occupation of wage earners in families having cases.*

[Including all cases studied within and without New York City. Total, 729 cases, occurring in 612 families.]

36 different places of occupation employing members of 2 separate families having cases.	
14 different places of occupation employing members of 3 separate families having cases.	
5 different places of occupation employing members of 4 separate families having cases.	
2 different places of occupation employing members of 5 separate families having cases.	
3 different places of occupation employing members of 6 separate families having cases.	
1 place of occupation employing members of 7 separate families having cases.	
1 place of occupation employing member of 14 separate families having cases.	
Total families	183
Number of families the wage earners of which were not associated at their places of employment with members of any other family having cases	429
Total	612

CONTACT RELATION OF FIRST CASES TO PREVIOUS FOCI OF THE DISEASE.

In the first part of this section there have been traced the general geographical and chronological details of the spread of the disease outside of New York City. Supplementary to this, further details are added here regarding the first cases in various places in relation to previous foci of the disease.

HARTFORD COUNTY, CONN.

The contact history of the first cases in the various places investigated in this county are shown in the following table:

TABLE No. 100.—*Contact history of first case in all towns investigated in Hartford County, Conn.*

	Direct or indirect contact with definite or suspicious case.	Visit to infected district.	Association with people from infected district.	Contact with general public only.	No history of any possible contact.
Hartford			Probable		
New Britain			Indirect		
Glastonbury		East Hampton, Middletown.	Yes		
Windsor			do		
Windsor Locks		New York City	New York		
Enfield			Springfield		
Farmington			Indirect		
Southington		New Haven	New York		
South Windsor		Hartford	Hartford		
West Hartford			do		
Avon			Indirect		
Suffield					Yes.
Berlin		New Britain	New Britain		
Simsbury			Bridgeport		
Granby			Berlin		
East Granby		Hartford, Springfield	New York		
Bloomfield		Hartford	Hartford		
Plainville			New York		
East Hartford	Yes		Hartford		

MIDDLESEX COUNTY, N. J.

The contact history of the first cases in the various places in this county are shown in the following table:

TABLE No. 101.—*Contact history of first case in all towns investigated in Middlesex County, N. J.*

	Direct or indirect contact with definite or suspicious case.	Visit to infected district.	Association with people from infected district.	Contact with general public only.	No history of any possible contact.
Cranberry			Yes		
East Brunswick			Yes		
Highland Park			Yes		
Jamesboro			Yes		
Madison			Yes		
Monroe				Yes	
New Brunswick			Yes		
North Brunswick			Yes		
South Brunswick	Yes				
Spotswood		Yes			

HUNTERDON, WARREN, AND SUSSEX COUNTIES, N. J.

Of the three counties, Hunterdon showed the first infection on July 8. This first case, through family connection, came into close contact, prior to illness, with persons from Newark, N. J. (an infected district). The first case in Sussex County occurred on July 19. This could not be traced to any definite source. The first case in Warren County occurred on August 1 and gave a history of association, prior to illness, with persons from Newark, N. J.

The contact history of the first cases in the various places investigated in these three counties is shown in the following table:

TABLE No. 102.—*Contact history of first case in all places investigated in Hunterdon, Warren, and Sussex Counties, N. J.*

	Direct or indirect contact with definite or suspicious case.	Visit to infected district.	Association with people from infected district.	Contact with general public only.	No history of any possible contact.
Hunterdon County:					
Lambertville City			Probable.		
Readington Township			Yes		
Lebanon Township	Probable.		Yes		
Clinton Township		Yes			
Delaware Township	Yes				
Tewkesbury Township			Yes		
High Bridge Borough	Yes				
East Amwell[1]					
Franklin Township			Yes		
Bethlehem Township			Yes		
Hampton Borough				Yes	
Warren County:					
Lopatcong Township		Yes			
Allamuchy Township			Yes		
Sussex County:					
Newton City				Yes	
Wantage Township				Yes	
Frankfort Township			Probable.		
Montague Township	Yes				

[1] Case developed in Jersey City, N. J.

SUMMARY.

Summarizing the histories of these first cases in the various places where such investigations were made, we obtain the results shown in the table below:

TABLE No. 103.—*Summary of histories of first cases.*

Locality.	Number of places investigated.	Direct or indirect contact with previous definite or suspected case.	Visit to infected district.	Association with people of infected district.	Contact with general public only.	No history of any kind of contact.
Hartford County	19	1	7	[1] 10		1
Middlesex County	10	1	1	7	1	
Hunterdon, Warren, and Sussex Counties	[2] 16	[3] 4	2	[4] 7	3	
Total	45	6	10	24	4	1

[1] One probable.
[2] One case developed elsewhere and is not considered.
[3] One probable.
[4] Two probable.

It will be seen from this table that of the 45 first cases investigated 40 (or 88.8 per cent) gave histories of direct or indirect contact with a previous case or else direct or indirect association with infected districts. Even when consideration is given to the opportunity of free communication which exists, to a greater or less degree, between the places investigated and neighboring infected districts, this is considered a remarkable demonstration.

CONTACT RELATIONSHIP BETWEEN CASES.

The contact relationships between the various cases investigated in the foregoing counties are given in the following table. In this table only those cases are included in which some history of contact could be elicited. The other cases are omitted. In this table, as, indeed, throughout this report, where the question of contact is discussed, the time element is, of course, given consideration. The general rule was that contact should be shown within two weeks previous to illness. This rule was generally followed.

TABLE No. 104.—*Poliomyelitis outside New York City—Cases giving history of contact with a previous case of the disease.*

Locality.	Total cases investigated.	Cases showing direct contact with previous definite or suspected case.		Cases showing indirect contact with previous definite or suspected case.		Total cases showing direct or indirect contact, positive or probable.	
		Positive.	Probable.	Positive.	Probable.	Number.	Per cent.
Hartford County	117	34	5	7	1	47	40.0
Middlesex County	[1] 90	22	3	8	1	34	37.8
Hunterdon, Warren, and Sussex Counties	56	20	7	3	2	32	57.1
Total	263	76	15	18	4	113	43.0

[1] Including the New Brunswick and Highland Park cases.

It is thus seen that in this investigation of 263 cases in these counties 113 (or 43 per cent) gave a history of either direct or indirect contact, positive or probable, with a previous case of the disease. This very high percentage of cases showing contact with a previous case is due to the fact that most of the cases investigated occurred in rural or semirural districts, where the personal relations of existence are comparatively simple and much more easily traced than is possible under the complexities of urban life.

Considering this table it is worthy of additional comment that of the 34 Middlesex County cases 21 occurred in the township of New Brunswick. This very high percentage of contact cases justifies a word or two upon conditions in this place.

The population of the township is 2,929. Cases reported 39, of which 34 were investigated. The attack rate for the township was 1,331 per 100,000. A history of contact, direct or indirect, with a previous suspected or positive case of poliomyelitis was obtained in 21 cases, or 61.7 per cent; 4 cases, or 10.3 per cent, gave a history of having come from an infected district—3 from New York City and 1 from Jersey City, N. J.; 5 cases had come into contact with people from New York City, 3 with people from Newark, N. J., and 1 with people from East Orange, N. J. The remaining 5 cases were not investigated.

It is quite remarkable that in all the cases investigated there was obtained either a history of contact with a previous case, a visit to an infected district, or association with persons from infected districts. The cases were fairly well scattered over the entire township with, however, a tendency to grouping in the center of the place.

With regard to the cases occurring in Hunterdon, Warren, and Sussex Counties it may be of interest to say that the largest grouping of cases occurred as follows:

Hunterdon: The villages of Hampton Junction and Glen Garden with 19 cases in a combined population of 1,018. The cases all occurred in August and September.

Warren: Hackettstown, population 2,976, 11 cases, all in September and October.

Sussex: Newton, population 4,433, 9 cases during July, August, September, and October.

Only 56 cases were investigated in these three counties. Of the total 87 cases reported from them, however, it was established that 47 per cent occurred in strictly rural families, and 46 per cent in families living in small populated centers. In short, practically the entire epidemic in these counties was rural.

MISCELLANEOUS CASES.

In addition to the above studies, there were investigated 137 additional cases, widely scattered through various parts of Connecticut and Rhode Island. The nature of this investigation does not lend itself to such analysis as has been given above. The data obtained from these cases have already been used in various ways in preceding pages and will be further used in subsequent pages. It may be said here, however, that of the 137 miscellaneous cases studied 41 (or 30 per cent) gave histories of positive or probable contact, either direct or indirect, with a previous definite or suspected case of poliomyelitis. A very large number of the cases (57 or 41.6 per cent) gave histories of a visit to an infected district or more or less association with people from infected districts, and of these 33 gave histories of such association with New York City.

MULTIPLE CASES IN FAMILIES.

In the following table is given a summary of the multiple cases in families of all cases investigated outside of New York City. The results shown by this table correspond quite closely to similar data obtained in the Richmond Borough studies, and do not vary greatly from the data compiled for the general epidemic in New York City, which are based, of course, upon a much larger number of cases.

TABLE NO. 105.—*Intensive studies outside of New York City—Distribution of cases, by families.*

INCLUDING SUSPICIOUS CASES.

Families showing—	Number of families.	Number of cases.	Per cent of total families.	Per cent of cases.
1 case in family	263	263	84.7	70.5
2 cases in family	35	70	10.4	17.4
3 cases in family	16	48	4.7	11.9
4 cases in family	0	0	0	0
5 cases in family	0	0	0	0
Total	334	401		
EXCLUDING SUSPICIOUS CASES.				
1 case in family	297	297	90.5	80.9
2 cases in family	23	46	7.01	12.5
3 cases in family	8	24	2.4	6.5
4 cases in family	0	0	0	0
5 cases in family	0	0	0	0
Total	328	367		

Percentage of total families with more than 1 case (including suspicious) 15.2
Percentage of total families with more than 1 case (excluding suspicious) 9.4

SECONDARY CASES IN FAMILIES.

In the following table is given a combined summary of secondary cases occurring in the families of all cases studied outside of New York City, along with the secondary attack rate. The table differs a trifle from the similar one presented in the Richmond Borough studies. The age periods are not exactly the same, but are so arranged that, if desired, the two tables may with little trouble be made exactly comparable. The secondary attack rates, as shown here, do not differ materially from those of the studies elsewhere presented in this report.

TABLE No. 106.—*Intensive studies outside of New York City—Family summary showing primary and subsequent cases.*

PARALYTIC, ABORTIVE, AND SUSPICIOUS CASES INCLUDED.

Ages.	Number of cases, primary	Total persons in families involved.	Number of persons exposed at age indicated	Secondary cases.	
				Number.	Attack rate.
All ages	335	2,238	1,903	62	3.2
Under 1 year			71	5	7.04
1 to 5			265	35	13.2
6 to 10			245	11	4.4
11 to 15			173	4	2.3
16 to 20			69	0	0.0
Over 20			1,080	7	.64

SUSPICIOUS CASES EXCLUDED.

Ages.	Number of cases, primary	Total persons in families involved.	Number of persons exposed at age indicated	Secondary cases.	
				Number.	Attack rate.
All ages	329	2,199	1,870	35	1.9
Under 1 year			69	3	4.3
1 to 5			259	17	6.5
6 to 10			239	7	2.9
11 to 15			169	4	2.3
16 to 20			69	0	0.0
Over 20			1,065	4	.37

SUSPICIOUS AND ABORTIVE CASES EXCLUDED.

Ages.	Number of cases, primary	Total persons in families involved.	Number of persons exposed at age indicated	Secondary cases.	
				Number.	Attack rate.
All ages	315	2,137	1,822	19	1.04
Under 1 year			67	2	2.9
1 to 5			254	9	3.5
6 to 10			234	3	1.2
11 to 15			167	1	.59
16 to 20			67	0	0.0
Over 20			1,033	4	.38

GENERAL CONTACT AS SHOWN BY THE COMBINED STUDIES.

In the intensive studies, effort was made always to trace contact relationships between cases of the disease. The results of these investigations are shown in the table given below. It was thought wise to combine in this table the results obtained from the entire series of cases studied, both in New York City and elsewhere.

TABLE No. 107.—*Combined summary—Intensive studies all cases investigated within and without New York City.*

	Cases.	Per cent.
Number and percentage of cases showing contact with previous case: Total investigated	729	
Number showing direct contact with previous case, definite or suspicious	160	21.9
Number showing indirect contact with previous case, definite or suspicious.	34	4.7
Total cases showing contact, direct or indirect, with previous definite or suspicious case	194	26.6
Total cases showing contact, direct or indirect, with previous definite case (suspicious excluded)	151	20.7

The component groups of cases which form this table represent environmental conditions which are often radically different from each other. As a consequence of this and other circumstances there occurs much variation among the different groups as to the proportion of cases in which can be obtained a history of contact with some previous case of the disease.

For example, in the Richmond Borough studies, contact of this kind could be shown in 28 per cent of the cases; in Hartford County, Conn., 29.9 per cent; in the city of Bridgeport, Conn., 19 per cent; and in the small group of cases studied in the city of New Brunswick, N. J. (and its residential suburb, Highland Park), a satisfactory history of contact could not be obtained in any case. Comment has been made on the very high percentage of cases showing such contact in the studies made in Hunterdon, Warren, and Sussex Counties, N. J., a population living almost entirely under rural conditions.

DEVELOPMENT OF SECONDARY CASES AS SHOWN BY COMBINED STUDIES.

In the following table is given the interval which elapsed between the date of contact and the date of onset in all the cases studied intensively, both within and without New York City, where previous recent contact could be established with a definite or suspected case of the disease. Along with this is given similar information for secondary cases in families. This latter might be thought perhaps to possess a little greater degree of accuracy in the more exact establishment of time intervals. It permits, moreover, a comparison with a similar table taken from Wickman's 1905 studies in Sweden. This table from Wickman has already been given, but for convenience is repeated here.

Table No. 108.—*Combined summary—Intensive studies, all cases investigated, within and without New York City.*

ALL SECONDARY CASES IN WHICH CONTACT WAS ESTABLISHED, SHOWING INTERVAL ELAPSED BETWEEN DATE OF CONTACT AND DATE OF ONSET.

[Total cases investigated, 729.]

Direct and indirect contact.	Interval by days.													Total.
	1	2	3	4	5	6	7	8	9	10	11	12	Over 12.	
Suspicious cases excluded	13	18	16	12	19	14	9	7	3	8	7	1	24	151
All cases included	18	23	27	15	23	17	12	8	4	10	8	4	25	194
Per cent of total cases developing each day	9.2	11.8	13.8	7.7	11.8	8.7	6.1	4.1	2.06	5.1	4.1	2.06	13.8	....
Per cent of total cases each day, cumulative	9.2	21.1	35.05	42.7	54.06	63.5	69.5	73.7	75.9	80.9	85.05	87.1	100	....

SECONDARY CASES IN FAMILIES, WITH A TABLE FROM WICKMAN FOR COMPARISON (EXCLUDING SUSPICIOUS CASES).

	Interval by days.														Total.
	0	1	2	3	4	5	6	7	8	9	10	11	12	Over 12.	
Public Health Service	18	8	7	9	3	8	7	4	2	0	3	0	0	5	74
Wickman	12	22	15	14	11	7	9	7	5	5	5	1	2	12	127

When percentages are figured on the total cases, as is done in the first table, it is noticed that the highest figures for each day occurred during the first five or six days, and that nearly 70 per cent of the total cases developed during the first seven days.

C. SUMMARY.

Summarizing, rather broadly, the results of both the general and detailed studies of the 1916 epidemic outside of New York City, stress may again be placed upon the size of the epidemic both in numbers involved and the wide area of territory implicated. This very magnitude of the outbreak, hitherto unrecorded for this disease, gives to the statistical information collected an extraordinarily high value.

The results of these studies, like those in New York City, under radically different conditions, accord in general with the epidemiologic features previously observed in other epidemics which have been studied, and have the value therefore of confirming them. There are, however, one or two additional things which deserve notice.

The mass movement of the epidemic as traced by States, minor civil divisions, travel routes, and by arbitrary, concentric zones, shows just as distinctly as in New York City a definite wavelike movement, traveling with chronologic regularity, outward from a central focus and diminishing in amplitude as it recedes from the central point. This excursion seems to possess no significance except in relation to the movements of human beings, and consequentlly supports the idea of contact, in the broad sense, as the principal factor in the spread of the disease.

As regards the relation between recognized cases of poliomyelitis, the evidence derived from the intimate study of rural groups is consistent with that derived from the similar study in Richmond Borough, New York City, and from studies of previous epidemics—namely, that in a large majority of cases no definite lines of contact, direct or indirect, can be established. However, as would be expected, the proportion of cases showing such contact is somewhat higher in the less complex rural groups than in New York City. Also, in a significant proportion of the more isolated rural cases, where no definite contact could be established with a previous case, a history was obtained of association with known infected localities—that is, with possible passive virus carriers.

In addition to this important result of the studies of this section it may be added that Frost's statement of the difference in age incidence observed in urban and rural outbreaks is confirmed. This is an important observation and its significance should not be overlooked.

It is particularly disappointing that, notwithstanding the mass of material available, none of the observations made permit any deductions of an exact nature with regard to the incubation period of the disease. From these studies it can be said only that the usual period appears to be less than one week.[1]

---

[1] A prolonged period of incubation may be accounted for by the possible development of the carrier state in the individual previous to his actual infection. This is known to occur in some other diseases.

IV. MISCELLANEOUS STUDIES.

In the course of these investigations certain miscellaneous matters received more or less attention. These did not get the same degree of concentrated effort as that expended upon other subjects reported in these pages. This was due not to any intrinsic lack of importance in the questions themselves, but simply to want of time. It is proposed in this brief chapter to summarize these miscellaneous matters, since they do not well fit into any other part of the report.

PARALYTIC DISORDERS OF DOMESTIC ANIMALS.

As already noted, there has long existed a suspicion of some etiologic relationship between paralytic disorders among domestic animals and poliomyelitis in human beings. Not a little attention has been devoted to this subject in the literature of poliomyelitis, and some authors have attached much importance to it.

In addition to inquiries made in the intensive studies with regard to the presence of animals upon the premises and sickness occurring among them, a special investigation was also undertaken as to the general prevalence of paralytic disorders among animals, especially in New York City and vicinity.

For the purpose of obtaining such information the following procedures were adopted: A questionnaire was mailed to a large number of veterinarians; personal visits were made to veterinary hospitals; personal visits were made to many residences; arrangements were made with the Society for the Prevention of Cruelty to Animals to see all paralyzed animals at their large shelter in Manhattan; and post-mortem material was collected from several such animals in various places.

The questionnaire was sent to all veterinarians and veterinary hospitals in the Borough of Manhattan and in Newark, N. J. About 180 of these forms were mailed soliciting the following information:

(1) How many paralyzed animals have you seen during the past six months? Dogs ———, cats ———, other animals ———.

(2) In your experience have paralyzed animals been more numerous during the present summer than in previous summers? Please comment freely.

Twenty reliable replies were received. These, of course, covered a wide range. Some gave evidence of a distinct increase of paralytic disorders affecting animals, while others of wide experience and large practice gave equally strong negative evidence. One veterinary hospital handling over 10,000 cases a year reported less paralysis among animals during the six months preceding their reply than for any similar period of its entire 34 years of existence.

With due consideration for personal prejudices and opinions, the replies received, on the whole, showed rather a decrease than any increase of paralysis among animals during the six months preceding (February to August, 1916), when comparison is made with any similar period of time for other years.

A number of veterinary hospitals were visited and the veterinarians and attendants personally questioned. The clinical reports of the places were also examined. The same general conclusion was reached as above.

At our request cards were referred to us by the house-to-house visitation committee of the department of health of New York City, and when sick animals were reported the houses in question were visited and the animals inspected. A large number of such visits were made, but nothing of consequence was found except negative evidence. As a rule the reported sickness among animals did not exist, and the discovery of anything like a definite paralysis among them was very exceptional.

Through the courtesy of the Society for the Prevention of Cruelty to Animals an arrangement was made whereby prompt notification was given of the occurrence of any case of sickness accompanied by paralysis among the animals held in the large shelter in Manhattan Borough. Although this shelter was constantly receiving an enormous number of animals, cases of sickness with paralysis were very rare indeed. During several weeks of observation less than 10 such cases were reported among thousands of animals from various parts of New York City.

Both within and without New York City effort was made to discover paralyzed animals, particularly when occurring in connection with any case of poliomyelitis. In this way autopsy material was collected at various places from 23 suspicious animals. This material was preserved in glycerin and sent to the Hygienic Laboratory.

In the course of the investigation paralytic disorders were recorded among dogs, cats, chickens, ducks, calves, monkeys, bears, and goats. Such disorders are not uncommon among various animals. None of the evidence collected, however, gave indication of any increase of these conditions among animals in the epidemic area.

In New York City, where a record is kept of all dead animals removed from the streets, their number during the epidemic was found greatly to exceed that for similar periods in preceding years. It is not believed, however, that this was due to any increased death rate among the animals from disease, but more likely to a desire on the part of the owners to rid themselves of what was popularly regarded as a possible source of infection. This tendency is strikingly confirmed by the equally great increase during the same period in the number of animals to be killed which were delivered to the Society for the Prevention of Cruelty to Animals, as shown by their records.

The epidemiologic evidence collected during the progress of this investigation lends no support to the idea of any relationship between paralytic disorders of animals and the occurrence of poliomyelitis in human beings. The evidence obtained in the laboratory by experimentation with the autopsy material which was collected, forms really no part of this report. It would seem appropriate here, however, to say that this material was, with the usual technique, inoculated into various animals including, in many instances, animals of like species as well as monkeys. The results were entirely negative.

ENTOMOLOGICAL SURVEYS.

For a brief while an entomologist was attached to the staff engaged in the investigations, largely for the purpose of making observations and collecting data and material to be used in subsequent experimental studies in the laboratory.

While engaged in this work entomological surveys were made in numerous places. Naturally, under the circumstances, these field studies were brief and of a very general nature. So far as this report is concerned, they led to no results of consequence.

RODENT SURVEYS.

It has been suggested by Richardson[1] and perhaps others that rats and possibly other rodents may be a factor in the spread of poliomyelitis. The field force engaged in these investigations expended a good deal of time and effort in making rodent surveys in a number of different places in the epidemic area. A careful examination of the data collected, however, seemed to lend no support to the idea, and further investigations of this kind were abandoned.

COLLECTION OF HUMAN AUTOPSY MATERIAL.

It may be simply recorded here that the demand for material of this kind was large. In order to secure sufficient for the purposes of the laboratory it was found necessary to devote considerable time to its collection. Ultimately material, in large or small quantities, was secured from about 40 different autopsies in New York City and Newark, N. J. This was all preserved in glycerine and sent to the Hygienic Laboratory for further study.

---

[1] Richardson, M. W., The Rat and Infantile Paralysis: A Theory. Boston Med. and Surg. Jnl., Vol. CLXXV, 12, 397–400, 1916.

V. FINAL SUMMARY.

A review of the history of poliomyelitis prior to 1916 shows, as the outstanding feature of its epidemiology, a recent and rapid development of epidemic prevalence. Since 1868, when the first clearly defined epidemic was recorded, the recognized epidemics of this disease have increased in number of cases from a score to several thousands, in territory involved from a single village to whole States. This evolution has been steadily progressive, every few years witnessing an epidemic surpassing all previous experience, and it has gone forward in many countries, perhaps throughout the world. It appears, however, to have originated in Sweden or Norway, and to have been most marked in these countries and the United States. Along with this increase in epidemic prevalence has come an apparent but less clearly defined increase in severity of clinical manifestations, likewise originating, or at least first recorded, in Sweden and Norway.

Since 1909, the first year for which any general mortality and morbidity statistics are available, poliomyelitis has figured each year in the mortality records of every State in the United States having a registration population of 500,000 or more. From 1909 to 1915 the annual mortality rate from poliomyelitis in the registration area of the United States has varied from 1 to 2.7 per 100,000. The annual number of deaths in this area has varied from 569 to 1,459, corresponding to estimated totals for the whole United States of about 1,020 and 2,150, respectively. The cases reported, in records known to be incomplete, have varied from 1,860 to 7,320 per annum, corresponding to conservatively estimated totals of about 5,000 to 12,000. During this period (1909 to 1915) the disease was constantly endemic throughout the United States, and almost every year witnessed more or less severe epidemics in various sections. However, prior to 1916, the highest prevalence recorded in any whole State was about 87 cases per 100,000 in Vermont, in 1914. In no other State or other population group of 500,000 or more had the prevalence reached 50 per 100,000.

As compared with this prevalence in previous years, incomplete data for the year 1916 show approximately 29,000 cases, with 6,000 deaths reported in the United States, of which numbers 23,000 cases, with 5,000 deaths occurred in the northeastern States, in distinct relation to the New York epidemic, in a population of about 32,000,000. In New York City, in 1916, the disease reached a prevalence of 185 per 100,000 in a population of 5,600,000; in New Jersey, 134 pe 100,000 in nearly 3,000,000 population; in New York State, exclusiv of New York City, 78 per 100,000 in 4,670,000; and in Connecticu 72 per 100,000. This epidemic, therefore, far surpassed all previou records, not only in its extent, but also in its intensity. Accordingly i has a distinct significance as marking a new stage in the evolution o epidemicity in poliomyelitis. From the standpoint of epidemic logic study it has the further significance that it has resulted in th collection of a uniform mass of data far in excess of any hithert available.

In certain of its features the epidemic of 1916 conforms closely t previous experience, while in others it is distinctly remarkable. I is quite similar to earlier epidemics in its season of occurrence, it selective age incidence, its relatively uniform distribution in th various social and economic strata of population, the lack of demonstrable relation between incidence of infection and hygienic conditions in the immediate environment, and in the great majority o cases the entire absence of any traceable relation with a previous case of the disease. The features which may be considered most remarkable are an extent and intensity beyond all previous experience an origin remarkably definite as to time and place, a strikingly uniform radial spread from this focus with intensity progressively decreasing in proportion to distance from the center, and, in general a demonstrable mathematical regularity in its whole evolution. Concerning these usual and unusual features, respectively, it may be stated broadly that the epidemic was unusual in those larger features which are demonstrated by broad statistical analysis; quite similar to previous epidemics in the detail brought out by intensive study. It is, of course, quite probable that any or all these apparently unusual features may have been more or less constantly present in other epidemics, but not clearly demonstrable with the data at hand.

The epidemic had a peculiarly well-defined origin, during the latter half of May, in a certain locality in the Borough of Brooklyn; and its whole subsequent development bears a distinctly traceable relation to this origin. As to its essential cause, the special conditions which led to the development at this time and place of such an extraordinary epidemic, nothing is known. The epidemic may have been inaugurated either by the introduction into the city of a new strain of virus or by a "flare-up" of the endemic infection long present. In either event the mystery surrounding its origin is not peculiar to this epidemic or to this disease. The origin of most epidemics of endemic contagious diseases, such as scarlet fever, measles, diphtheria, cerebrospinal meningitis and others, is equally mysterious.

In New York City the epidemic had reached its maximum by the second week in August, thence declining to a vanishing point about November 1. By this time the number of cases in the city had reached 9,345, with 2,243 deaths, a case mortality of 24 per cent. As is usual the disease was confined almost exclusively to the child population, 79.2 per cent of the cases being in children under 5 and approximately 98 per cent in those under 15 years of age. The case fatality was lowest in the age group 1 to 4 years, and progressively higher in each successive higher age group.

In the city as a whole the epidemic, both in its development and its decline, followed a geometric progression so well defined that during the later stages of the epidemic it was possible to forecast its further course with surprising accuracy. Following, in more detail, the chronology of the epidemic, its development was not simultaneous in all sections of the city, but progressive, wavelike. In those sections where the epidemic began earliest it had already reached its crest and begun to decline while it was still reaching a maximum in the sections attacked later. This progression was in the nature of a radial spread from the original focus in Brooklyn, as shown by a comparative study of the chronology of the epidemic in successive concentric zones centered at this point.

Considering separately the five boroughs of the city, the incidence rates per 100,000 of population were: In Queens, 318; in Richmond, 300; in Brooklyn, 246; in Manhattan, 125; and in the Bronx, 112. The boroughs are therefore sharply divided into two groups—namely, Queens, Richmond, and Brooklyn with an average and fairly uniform incidence of 261 per 100,000; Manhattan and Bronx with an average rate of 122. In the three years preceding the epidemic, the incidence of poliomyelitis in these respective groups bore an inverse relation to the epidemic incidence; thus, in the former group (Queens, Richmond, and Brooklyn) it was 5.75[1] per 100,000, while in the latter it was 14.4[1] per 100,000. The idea naturally suggests itself that the higher endemic prevalence of poliomyelitis in Manhattan and Bronx in the preceding years may have rendered their population more generally immune to the epidemic infection than was the population of the other boroughs.

Considering still smaller subdivisions of the city—namely assembly districts—the local distribution of the disease within the several boroughs was remarkably uniform. The same is true of the distribution by wards in the city of Newark, N. J. Comparison with an epidemic of measles in Newark and one of scarlet fever in Chicago shows that the distribution of poliomyelitis was more uniform than that of these diseases, thus confirming the impression that the incidence of poliomyelitis is relatively independent of such local conditions as the density, economic status, and housing of the populatio in different sections of the city.

---

[1] These figures represent the total incidence rates for the whole period of three years, 1913 to 1915, inclusive; not the average annual rate for these years.

Outside of New York City the epidemic extended over an area o approximately 300 miles radius, including the States of New York New Jersey, Pennsylvania, Delaware, Maryland, Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, and Maine Throughout this area the evolution of the epidemic was remarkabl regular in that, with increasing distance from New York city, it development was progressively later and its total incidence in th population less, as demonstrated by comparison of successive concentric 50-mile zones. It is, however, only in a broad sense, considering large population groups, that the extension from New Yor city shows this regularity. More detailed analysis shows that th extension was primarily to the larger centers of population and traffic in closest communication with New York, thence to the smaller urba and rural communities surrounding these secondary centers. Also comparing individual cities or counties, in the same distance zone there is considerable irregularity of distribution. For example, the incidence was much higher in Newark, N. J., than in Jersey City; much higher in Syracuse, Cortland, and Ithaca, N. Y., than in the other cities in the same zone. Considering the whole epidemic area and excluding the metropolitan districts of New York, Philadelphia, Boston, and Providence, the incidence was higher in the rural districts and cities under 50,000 than in the larger cities. Further comparison of rural with urban districts confirms previous observations as to the difference in age distribution of cases—namely, that in the rural districts a larger proportion of cases occurred in the higher age groups, suggesting a less general immunity of the older population than is found in metropolitan centers.

During the early stages of the epidemic a large number of people, including many children, removed temporarily from New York to smaller cities and rural districts in the adjacent States, and quite naturally a number of these people subsequently developed poliomyelitis in their new residences. The number of cases known to have occurred in persons recently removed from New York City constituted only one and four-tenths per cent of the total cases reported in the States of New Jersey, Connecticut, Rhode Island, and Massachusetts; but in 36 of the 398 cities which reported poliomyelitis in these States the earliest reported case was in a person who had recently come from New York City.

Analysis of the more detailed data collected in intensive studies of selected areas both in New York City and in the outside territory brings out features which, as previously stated, confirm the results of similar studies of previous epidemics. According to all available evidence the extension of the epidemic was independent of such factors as mass infection of food, milk, or water supplies; racial origin and economic status of the population, and of the various environmental conditions systematically studied. Special studies of a possible relation between the spread of infection and the occurrence of some hypothetical epizootic among rats, cats, dogs, or other lower animals yielded entirely negative results, as did entomological studies, which, however, were not carried out on an extensive scale. In individual cases contact, either direct or indirect, with a previous case of poliomyelitis could but rarely be established, and in many instances the possibility of such contact could be satisfactorily excluded.

As has been usual in epidemics of poliomyelitis, the occurrence of more than one case in a family was relative rare. In New York City multiple cases occurred in 4.3 per cent of the families attacked. Outside of New York multiple cases occurred in slightly over 9 per cent of the 328 families for which full data were available. Considering as "secondary" all but one case in each family, even where the onset was simultaneous with that of the "primary" case, the secondary attack rate among the members of 8,709 families in which poliomyelitis occurred in New York City was 1.1 per cent. The smaller groups of families studied intensively in Richmond Borough and outside of the city show a combined secondary attack rate of 1.2 per cent when only paralyzed cases are considered. The inclusion of abortive cases increases this attack rate to 1.8 per cent, and inclusion also of suspicious cases raises it to 3.4 per cent. These attack rates, which are consistent with those observed in previous epidemics of poliomyelitis, are notably lower than the secondary attack rates of scarlet fever (10 per cent) and diphtheria (6 per cent) as shown by Chapin's figures.

Evidence as to the probable incubation period of poliomyelitis is afforded by a study of the intervals elapsing between successive cases occurring in the same family. This information is available regarding 407 "secondary"[1] cases in New York City. In 15 per cent of these cases the onset was on the same day as that of the "primary" case, in 70 per cent within 5 days, in 80 per cent within 7 days, and in 90 per cent within 10 days. This is in close agreement with the less extensive data similarly compiled by Wickman. Similar studies with respect to scarlet fever and diphtheria show a somewhat smaller proportion of secondary cases developing simultaneously and within 5, 7, and 10 days, respectively, after the primary case. Additional data as to the incubation period is derived from a study of cases apparently "exported" from New York. In 28 recorded instances residents of New York leaving the city after the beginning of the epidemic there developed poliomyelitis after a known interval in other localities from which no cases of poliomyelitis had as yet been reported. In 23 of these 28 cases—that is, in 82 per cent—the onset occurred within seven days after departure from New York. The combined evidence of these special studies, while not conclusive, indicates that the incubation period of poliomyelitis is usually within seven days.

---

[1] Considering as "secondary" all additional cases in each family, even though their onset may be simultaneous with that of the "primary" case.

The observations made in this epidemic do not of themselves lead to a final conclusion regarding the transmission of poliomyelitis, but in the opinion of the writers they strongly confirm the general view presented and discussed in a foregoing section of this report (pp. 11–23). This view, which is presented not as a final conclusion but rather as the interpretation which seems most consistent with the facts now known, may be briefly summarized as follows:

1. That poliomyelitis is, in nature, exclusively a human infection, transmitted from person to person without the necessary intervention of a lower animal or insect host, the precise mechanism of transmission and avenues of infection being undetermined.

2. That the infection is far more prevalent than is apparent from the incidence of clinically recognized cases, since a large majority of persons infected become "carriers" without clinical manifestations. It is probable that during an epidemic such as that in New York City a very considerable proportion of the population become infected, adults as well as children.

3. That the most important agencies in disseminating the infection are the unrecognized carriers and perhaps mild abortive cases ordinarily escaping recognition. It is fairly certain that the frank, paralytic cases are a relatively minor factor in the spread of infection.

4. That an epidemic of one to three recognized cases per thousand, or even less, immunizes the general population to such an extent that the epidemic declines spontaneously, due to the exhaustion or thinning out of infectable material. Apparently an epidemic incidence relatively small in comparison to that prevailing in an epidemic may produce a population immunity sufficient to definitely limit the incidence rate in a subsequent epidemic.

It is, of course, to be expected that further experimental and epidemiologic research will modify this view and will more fully explain all the phenomena of this disease. It may, however, be noted that other more common infectious diseases, generally considered "familiar," present problems as little explained as those of poliomyelitis, and that broader studies of these diseases may be expected to assist in interpreting some of the facts established regarding poliomyelitis.

APPENDIX.

Table A.—*Incidence of poliomyelitis, New York City, 1911–1915—Reported cases and deaths for each borough and for the city, by months.*

1911

Months.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		City.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	1	......	......	......	5	......	......	......	......	......	6	......
February	......	......	......	......	5	......	......	......	......	......	5	......
March	......	......	2	......	......	......	1	......	......	......	3	......
April	......	......	......	......	3	......	......	......	......	......	3	......
May	2	......	......	......	1	......	......	......	......	......	3	......
June	2	......	......	......	1	......	......	......	......	......	3	......
July	13	......	1	......	1	......	2	......	4	......	21	......
August	15	......	3	......	5	......	3	......	1	......	27	......
September	34	......	11	......	10	......	......	......	3	......	58	......
October	63	......	10	......	13	......	1	......	2	......	89	......
November	38	......	6	......	18	......	1	......	4	......	67	......
December	48	......	16	......	4	......	4	......	1	......	73	......
Total	216	......	49	......	66	......	12	......	15	......	358	......

1912

Months.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		City.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	22	......	6	......	1	......	1	......	1	......	31	......
February	30	......	7	......	11	......	5	......	......	......	53	......
March	21	......	7	......	7	......	2	......	1	......	38	......
April	16	......	1	......	5	......	1	......	......	......	23	......
May	10	......	0	......	2	......	0	......	2	......	14	......
June	22	......	3	......	15	......	......	......	......	......	40	......
July	28	......	3	......	11	......	......	......	......	......	42	......
August	29	......	6	......	5	......	......	......	......	......	40	......
September	45	......	6	......	7	......	1	......	2	......	61	......
October	60	......	4	......	8	......	3	......	......	......	75	......
November	49	......	7	......	4	......	5	......	......	......	65	......
December	18	......	2	......	2	......	......	......	......	......	22	......
Total	350	......	52	......	78	......	18	......	6	......	504	......

1913

Months.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		City.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	9	......	2	......	1	......	......	......	......	......	12	......
February	3	......	......	......	1	......	1	......	......	......	5	......
March	3	......	......	......	......	......	......	......	......	......	3	......
April	3	......	2	......	1	......	1	......	1	......	8	......
May	3	......	2	......	6	......	......	......	......	......	11	......
June	4	......	1	......	2	......	......	......	......	......	7	......
July	23	......	5	......	10	......	......	......	......	......	38	......
August	18	......	15	......	11	......	......	......	......	......	44	......
September	50	......	15	......	28	......	2	......	......	......	95	......
October	25	......	9	......	12	......	2	......	......	......	48	......
November	11	......	8	......	1	......	......	......	......	......	20	......
December	8	......	3	......	2	......	1	......	......	......	14	......
Total	160	......	62	......	75	......	7	......	1	......	305	......

TABLE A.—*Incidence of poliomyelitis, New York City, 1911–1915—Reported cases and deaths for each borough and for the city, by months*—Continued.

Months.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		City.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1914												
January	10	2	2		1	1					13	3
February	9				2	2					11	2
March	5	2	2	2			1				8	4
April	5		1		1						7	
May	2					1					2	1
June	2				2		2	1	1		7	1
July	1		1		1	1	1	1			4	2
August	9	1	8	2	3		1				21	3
September	15	2	10	7	1						26	9
October	13	4	4	1	1			1			18	6
November	6	2				1					6	3
December	3				2		1				6	
Total	80	13	28	12	14	6	6	3	1		129	34
1915												
January	4		1	1	2	2					7	3
February	1	1			2						3	1
March	2		1		1						4	
April	3		1								4	
May	3	1			1						4	1
June	5						2	1			7	1
July	2	1	1	1	1						4	2
August	5		2		3		1				11	
September	8		2	1	1	1					11	2
October	13		1		6	1	1				21	1
November	9	2			4		3				16	2
December	2	1	1			1					3	2
Total	57	6	10	3	21	5	7	1			95	15
TOTALS. [Cases, 5 years; deaths, 2 years.]												
January	46	2	11	1	10	3	1		1		69	6
February	43	1	7		21	2	6				77	3
March	31	2	12	2	8		4		1		56	4
April	27		5		10		2		1		45	
May	20	1	2		10	1			2		34	2
June	35		4		20		4	2	1		64	2
July	67	1	11	1	24	1	3	1	4		109	4
August	76	1	34	2	27		5		1		143	3
September	152	2	44	8	47	1	3		5		251	11
October	174	4	28	1	40	1	7	1	2		251	7
November	113	4	21		27	1	9		4		174	5
December	79	1	22		10	1	6		1		118	2
Total	863	19	201	15	254	11	50	4	23		1,391	49

TABLE B.—*Poliomyelitis, New York City, 1916—Incidence of cases by day of onset, by boroughs and for the city.*

Day.	May.						June.						July.					
	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.
1							2		17			19	12		72	6	8	98
2							1		1			2	8	2	58	2		70
3									5	1	1	7	21	3	70	4	2	100
4							3		4			7	18	2	72	11	4	107
5									7		1	8	20	4	73	3	5	105
6	1					1			8			8	14	4	87	11	5	121
7							2		7			9	22	5	78	8	9	122
8			1			1	1		6		1	8	22	4	55	15	8	104
9			1			1	3		5			8	14	6	67	10	7	104
10							1		8			9	18	5	77	13	12	125
11							1		8		1	10	10	6	71	15	4	106
12									14		1	15	15	2	57	10	6	90
13							1		10			11	21	6	68	19	6	120
14							1		9	1	1	12	19	3	65	17	13	117
15			4			4	1		7		1	9	27	5	75	16	8	131
16							1		17		4	22	16	8	82	19	11	136
17			1			1	1		19			20	32	2	60	17	8	119
18							3	1	20			24	25	2	80	10	3	120
19							1		35			36	30	11	60	21	7	129
20			3	1		4	4		39		2	45	30	11	74	12	9	136
21			1			1	3		24			27	32	8	77	23	9	149
22			1			1	4	1	28	2	3	38	41	11	74	22	8	156
23			1			1	3		31	1		35	50	8	85	22	2	167
24			3			3	1	1	33	2	2	39	43	6	78	18	11	156
25	1		1			2	4	1	45		2	52	40	10	90	21	3	164
26	1		1			2	6	1	50	1	6	64	54	4	63	29	5	155
27			4			4	7	3	39		3	52	53	7	57	28	6	151
28	2					2	6	2	46	2		56	54	7	81	28	5	175
29			1			1	7		49	3	4	63	36	9	81	18	7	151
30	1				1	2	11	2	55		3	71	27	11	78	27	2	145
31			1			1							69	12	110	42	4	287
Total	6		24	1	1	32	79	12	646	13	36	786	893	184	2,275	517	197	4,066

TABLE B.—*Poliomyelitis, New York City—Incidence of cases by day of onset, by boroughs and for the city*—Continued.

Day.	August.						September.						October.					
	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.
1	70	16	119	38	4	247	36	14	18	7	2	77	5	4	2	2		13
2	48	7	93	33	3	184	19	12	13	13	3	60	6	6	3	3		18
3	55	7	61	34	2	159	18	10	8	5		41	1	4	3	6		14
4	43	17	84	36	1	181	25	3	10	4	1	43	6		3	1		10
5	37	15	76	38		166	18	2	17	7	1	45	2	4				6
6	57	16	56	27	1	157	15	4	5	8		32	7	1		1		9
7	54	14	54	22	3	147	8	4	9	6	1	28	4	2				6
8	32	18	51	25	5	131	12	5	13	4		34	1		3			4
9	49	12	49	14	2	126	12	2	12	3	1	30			1	3		4
10	53	14	59	26	1	153	10	5	6	7		28	2	1	1	1		5
11	47	13	35	24	3	122	18	2	3	3		26	1		1	3		5
12	55	10	40	26	4	135	7	7	5	3		22	2		2			4
13	51	13	50	19	2	135	7	8	10	2		27		2	1			3
14	47	11	41	19	1	119	12	3	8	4		27	5					5
15	42	11	29	16	2	100	15	3	8	4		30	2			2		4
16	49	10	39	17	3	118	10	3	5	5		23	1					1
17	42	11	27	20		100	9	4	4	3		20	2					2
18	35	11	48	16	1	111	11	6	4	8		29	1	1	1			3
19	45	13	27	24	4	113	7	3	5	3		18	4		1	1		6
20	51	8	25	10	2	96	6	2	6	3		17	1		1	1		3
21	35	12	22	9	1	79	4	3	2	6		15	1					1
22	33	7	22	8		70	8	6	3	3		20	2		1			3
23	33	4	17	10	1	65	8	7	4	4		23	2					2
24	29	10	20	12		71	12	1	9	4		26	1		1	1		3
25	44	7	19	17		87	6	5	2	1	1	15	1		1	2		4
26	36	3	19	10	0	68	6	3	4	1		14	1	2				3
27	32	12	22	2	3	71	7	4	6	1		18	1					1
28	31	11	14	11		67	5	2	3	2	2	14		1		2		3
29	19	7	8	5		39	2	1	1	1		5						
30	18	4	10	4		36	6	3	4		1	14						
31	21	5	10	6		42												
Total	1,293	329	1,246	578	49	3,495	339	137	207	125	13	821	62	28	26	29	0	145

TABLE C.—*Poliomyelitis, New York City, 1916—Reported cases and deaths by days and by boroughs, with daily and weekly summary for the city.*

[Prepared by the department of health of the City of New York.]

Date.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		The city.			
											By days.		By weeks.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
May 13	1										1		1	
14–22											0		0	
23					1						1			
24														
25														
26														
27														
28													1	
29	1				1						2			
30														
31														
June 1														
2														
3														
4													2	
5														
6					2						2			
7							1				1	1		
8					4						4			
9		1										1		
10	2				2						4		11	2
11						1						1		
12					2						2			
13	1				1	1					2	1		
14	2				2						4			
15	1										1			
16					3						3			
17					3	1					3	1	15	3
18						1						1		
19	1				1						2			
20		1			7	1	1		1		9	2		
21					12	5					12	5		
22	2				16	1					18	1		
23	1				42	1					43	1		
24	1				12	2					13	2	97	12
25					10	9					10	9		

TABLE C.—*Poliomyelitis, New York City, 1916—Reported cases by days and by boroughs, with daily and weekly summary for the city*—Continued.

Date.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		The city.			
											By days.		By weeks.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
June 26	1	......	......	......	22	5	1	......	1	......	25	5	......	......
27	6	2	......	......	38	5	......	......	......	......	44	7	......	......
28	4	3	......	......	23	6	1	......	2	......	30	9	......	......
29	......	......	......	......	45	10	1	......	3	......	49	10	......	......
30	11	2	1	......	38	6	......	......	......	......	50	8	......	......
July 1	8	......	2	1	45	10	4	......	2	1	61	12	269	60
2	5	1	3	......	18	7	......	......	6	......	32	18	......	......
3	8	1	3	......	20	8	1	1	9	4	41	14	......	......
4	9	......	......	......	77	24	......	......	......	......	86	24	......	......
5	10	1	2	1	80	7	5	......	6	......	103	9	......	......
6	16	2	3	2	90	21	1	1	3	......	113	26	......	......
7	13	2	3	......	60	15	3	2	8	......	87	19	......	......
8	12	......	2	......	74	13	1	2	6	......	95	15	557	125
9	8	3	3	......	66	14	8	1	3	1	88	19	......	......
10	30	3	......	1	77	9	1	......	4	1	112	14	......	......
11	15	6	7	3	151	20	13	3	6	......	192	32	......	......
12	13	4	1	......	131	12	13	1	5	......	163	17	......	......
13	17	2	3	......	76	18	12	3	10	1	118	24	......	......
14	14	6	6	......	122	16	11	8	9	1	162	31	......	......
15	30	7	4	......	87	16	12	2	11	2	144	27	979	164
16	14	4	6	......	65	9	6	2	5	2	96	17	......	......
17	18	3	1	2	65	7	20	2	1	......	105	14	......	......
18	7	2	3	......	83	18	13	4	15	2	121	26	......	......
19	26	3	6	......	82	19	13	4	13	4	140	30	......	......
20	13	3	1	2	81	23	15	3	7	......	117	31	......	......
21	16	7	4	1	36	16	14	7	11	1	81	32	......	......
22	23	9	5	2	82	19	17	6	8	3	135	39	795	189
23	28	3	5	2	58	14	18	2	6	2	115	23	......	......
24	18	6	6	1	53	19	11	4	1	1	89	31	......	......
25	42	9	12	3	75	23	16	2	5	1	150	38	......	......
26	42	12	5	4	83	9	25	7	7	3	162	35	......	......
27	31	7	6	6	90	13	18	4	6	1	151	31	......	......
28	39	9	5	2	72	15	11	7	7	2	134	35	......	......
29	46	10	13	5	66	24	29	5	7	......	161	44	962	237
30	40	2	7	......	76	9	15	2	7	......	145	13	......	......
31	44	9	8	1	59	20	21	5	......	......	132	35	......	......
Aug. 1	42	12	8	......	83	33	17	10	9	......	159	55	......	......
2	46	17	8	......	88	16	30	8	4	......	166	41	......	......

3	76	11	8	2	92	21	33	8	8	1	217	43	....	....
4	52	10	9	1	84	32	28	2	3	....	175	45	....	....
5	51	7	7	2	83	22	27	9	5	1	173	41	1,167	278
6	45	12	19	3	93	9	34	7	1	2	192	33	....	....
7	38	9	5	4	79	24	19	7	4	....	145	44	....	....
8	54	15	9	1	89	29	31	8	....	1	183	52	....	....
9	47	14	15	7	89	21	31	15	1	....	183	57	....	....
10	44	9	14	3	84	20	30	6	3	....	175	38	....	....
11	50	7	10	6	73	10	28	7	4	1	165	31	....	....
12	56	15	17	4	61	19	30	1	3	....	167	42	1,210	297
13	49	10	21	2	54	8	16	2	1	....	141	22	....	....
14	43	14	8	3	31	12	13	2	....	....	95	31	....	....
15	51	13	18	5	74	14	30	6	5	1	163	39	....	....
16	44	8	11	7	46	14	28	5	4	....	133	44	....	....
17	39	10	10	3	40	10	32	9	....	....	121	32	....	....
18	44	17	8	....	48	6	20	7	5	2	125	32	....	....
19	52	12	12	2	45	15	25	6	....	1	134	36	912	236
20	37	9	15	2	40	6	14	3	2	....	108	20	....	....
21	32	17	9	6	29	8	21	2	1	....	92	33	....	....
22	48	19	9	4	42	11	16	4	3	1	118	39	....	....
23	52	12	10	6	43	15	23	9	3	....	131	42	....	....
24	59	12	6	....	31	14	10	4	3	1	109	31	....	....
25	43	14	14	1	24	7	11	....	2	....	94	22	....	....
26	36	9	13	13	27	8	15	....	1	3	92	33	744	220
27	36	5	10	4	27	8	9	4	1	....	83	21	....	....
28	20	11	7	3	7	10	8	1	1	....	43	25	....	....
29	30	10	6	2	35	14	12	4	....	2	83	32	....	....
30	37	7	11	3	27	5	13	7	1	....	89	22	....	....
31	26	10	3	4	25	6	6	1	....	....	60	21	....	....
Sept. 1	34	8	7	1	20	5	5	1	2	2	68	17	....	....
2	27	7	9	1	13	10	11	1	1	....	61	19	487	157
3	33	11	9	....	13	4	5	5	1	....	51	20	....	....
4	22	4	7	2	9	8	2	2	....	....	40	16	....	....
5	15	9	8	4	12	7	6	1	2	....	43	21	....	....
6	26	9	10	3	10	8	5	2	2	....	53	22	....	....
7	30	7	14	4	10	13	7	3	....	1	61	28	....	....
8	23	8	6	1	11	3	7	2	1	1	48	15	....	....
9	24	3	8	....	14	3	9	3	....	1	55	10	351	132
10	20	8	3	1	12	4	9	1	....	....	44	14	....	....
11	8	6	4	....	7	2	1	1	....	....	20	9	....	....
12	19	....	5	1	8	7	5	....	1	....	38	18	....	....
13	9	6	8	1	8	2	5	....	1	....	31	9	....	....
14	19	9	6	....	7	1	4	1	....	....	36	11	....	....
15	24	6	8	1	3	1	7	2	....	....	42	10	....	....
16	13	4	8	1	13	4	7	4	....	....	41	13	252	84
17	12	7	1	....	5	2	1	....	....	....	19	9	....	....
18	5	2	2	1	6	2	1	1	1	1	15	6	....	....
19	12	4	10	2	9	6	4	....	....	....	35	12	....	....
20	8	3	6	4	3	....	1	2	....	....	18	10	....	....
21	10	3	4	....	11	2	2	1	....	....	27	6	....	....
22	9	3	3	2	5	5	3	1	....	....	20	11	....	....
23	13	2	2	1	4	2	7	2	....	....	26	7	160	61

TABLE C.—*Poliomyelitis, New York City, 1916—Reported cases by days and by boroughs, with daily and weekly summary for the city*—Continued.

Date.	Manhattan.		Bronx.		Brooklyn.		Queens.		Richmond.		The city.			
											By days.		By weeks.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Sept. 24	3	1	2	1	8	3	2	1	......	......	15	6	......	......
25	6	3	3	......	3	2	2	......	......	......	14	5	......	......
26	5	7	9	......	1	1	5	3	......	......	20	11	......	......
27	10	3	4	1	9	......	3	1	......	......	26	5	......	......
28	13	4	4	2	4	3	4	1	1	......	26	10	......	......
29	12	3	6	1	5	4	3	3	......	1	26	12	......	......
30	9	1	6	2	1	......	3	1	......	......	19	4	146	53
Oct. 1	4	5	6	1	5	......	......	......	1	......	16	6	......	......
2	6	5	1	......	3	3	......	......	......	......	10	8	......	......
3	4	2	3	3	2	2	2	1	1	......	12	8	......	......
4	10	4	6	1	4	1	3	1	......	......	23	7	......	......
5	8	3	......	......	2	......	2	1	1	......	13	4	......	......
6	4	5	6	1	5	......	3	......	1	......	19	6	......	......
7	5	2	5	1	1	2	1	......	1	......	12	5	105	44
8	1	3	1	2	2	......	4	1	......	......	8	6	......	......
9	4	3	5	2	3	......	1	1	......	......	13	6	......	......
10	7	2	5	1	1	1	2	......	......	......	15	4	......	......
11	5	......	3	1	1	......	2	......	......	......	11	1	......	......
12	5	2	2	1	......	1	......	......	......	......	7	4	......	......
13	1	2	1	1	1	2	......	......	......	......	3	5	......	......
14	8	3	1	......	2	1	4	......	......	......	15	4	‘2	30
15	2	1	......	......	......	......	......	......	......	......	2	1	......	......
16	1	1	1	1	2	2	1	1	......	......	5	5	......	......
17	4	5	......	2	2	3	1	1	......	......	7	11	......	......
18	2	1	2	......	1	1	2	......	......	......	7	2	......	......
19	3	......	......	......	2	......	1	......	......	......	6	......	......	......
20	3	1	3	......	1	......	1	......	......	......	8	1	......	......
21	3	2	2	......	......	1	1	......	......	......	6	3	41	23
22	6	1	2	......	......	1	......	......	......	......	8	2	......	......
23	......	......	......	......	1	1	......	......	......	......	1	1	......	......
24	2	......	2	......	2	......	......	......	......	......	6	......	......	......
25	1	......	......	......	......	......	2	......	......	......	8	......	......	......
26	5	1	1	......	1	......	......	......	......	......	7	1	......	......
27	4	1	2	3	1	2	......	1	......	......	7	6	......	......
28	2	......	......	......	1	1	2	1	......	......	5	2	37	12
29	3	......	1	......	......	......	1	......	......	......	5	......	......	......
30	......	......	......	......	1	......	......	......	......	......	1	......	......	......
31	2	......	2	......	......	......	......	2	......	......	4	2	......	......

TABLE D.—*Poliomyelitis, New York City, 1916—Incidence of cases by date of onset, by weeks, with rate of incidence per 100,000 and total (cumulative) incidence per 100,000 to end of each week.*

Week ending—	Cases per week.						Incidence per 100,000 population.						Total incidence (cumulative) per 100,000 to end of each week.					
	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	City.
May 6	1	....	....	....	....	1	0.05	....	....	....	....	0.02	0.05	....	....	....	....	0.02
13	....	....	2	....	....	2	....	....	0.1	....	....	.04	.05	....	0.1	....	....	.06
20	....	....	8	1	....	9	....	....	.4	0.3	....	.2	.05	....	.5	0.3	....	.24
27	2	....	12	....	....	14	.1	....	.7	....	....	.3	.14	....	1.2	.3	....	.5
June 3	6	....	25	1	2	34	.3	....	1.4	.3	2.0	.7	.4	....	2.6	.5	2.0	1.2
10	10	....	15	....	2	57	.5	....	2.5	....	2.0	1.1	.9	....	5.1	.5	4.1	2.3
17	6	....	84	1	8	99	.3	....	4.7	.3	8.1	2.0	1.2	....	9.8	.8	12.2	4.3
24	19	3	210	5	7	244	.9	0.5	11.7	1.3	7.1	4.8	2.1	0.5	21.5	2.0	19.3	9.1
July 1	53	9	356	12	26	456	2.5	1.5	19.8	3.0	26.4	9.0	4.5	2.0	41.2	5.0	45.6	18.2
8	125	24	493	54	33	729	5.8	3.9	27.4	13.6	33.5	14.4	10.4	5.8	68.7	18.6	79.1	32.6
15	124	33	480	100	56	793	5.8	5.4	26.7	25.2	56.8	15.7	16.2	11.2	95.4	43.8	135.8	48.3
22	206	53	507	124	55	945	9.6	8.6	28.2	31.2	55.8	18.7	25.8	19.8	123.5	75.1	191.6	67.0
29	330	51	535	164	39	1,119	15.4	8.3	29.8	41.3	39.6	22.2	41.3	28.1	153.3	116.4	231.2	89.2
Aug. 5	349	85	621	248	16	1,319	16.3	13.8	34.5	62.5	16.2	26.1	57.6	41.9	187.8	178.9	247.4	115.3
12	347	97	344	164	19	971	16.2	15.8	19.1	41.3	19.3	19.2	73.8	57.7	206.9	220.3	266.6	134.6
19	311	80	261	131	13	796	14.6	13.0	14.5	33.0	13.2	15.8	88.4	70.7	221.4	253.3	279.8	150.4
26	261	51	144	76	4	536	12.2	8.3	8.0	19.2	4.1	10.6	100.6	78.9	229.5	272.4	283.9	161.0
Sept. 2	176	65	95	48	8	392	8.2	10.6	5.3	12.1	8.1	7.8	108.8	89.5	234.7	284.6	292.0	168.7
9	108	30	74	37	4	253	5.0	4.9	4.1	9.3	4.1	5.0	113.8	94.4	238.8	293.9	296.0	173.8
16	79	31	45	28	....	183	3.7	5.0	2.5	7.1	....	3.6	117.5	99.4	241.4	300.9	296.0	177.4
23	53	31	28	30	....	142	2.5	5.0	1.6	7.6	....	2.8	120.0	104.4	242.9	308.5	296.0	180.2
30	44	19	29	10	4	106	2.1	3.1	1.6	2.5	4.1	2.1	122.1	107.5	244.5	311.0	300.1	182.2
Oct. 7	31	21	11	13	....	76	1.4	3.4	.6	3.3	....	1.5	123.5	110.9	245.1	314.3	....	183.8
14	11	3	9	7	....	30	.5	.5	.5	1.8	....	.6	124.0	111.4	245.6	316.1	....	184.4
21	12	1	3	4	....	20	.6	.2	.2	1.0	....	.4	124.6	111.6	245.8	317.1	....	184.8
28	8	3	3	5	....	19	.4	.5	.2	1.3	....	.3	125.0	112.1	246.0	318.3	....	185.2
Total	2,672	690	4,424	1,263	296	9,345	....	....	....	....	....	....	....	....	....	....	....	....

TABLE E.—*Poliomyelitis, New York City, 1916—Cases by weeks, by assembly districts.*

BOROUGH OF BROOKLYN.

Assembly district.	Cases for week ending—																						Totals.
	May—			June—				July—					August—				September—					October—		
	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	
1					2	1	7	19	13	7	8	7	9	8	2	1	2		2	2				90
2				1		3	6	10	11	16	22	27	36	13	12	2	3	2	1			1		166
3		2	1	4	8	16	24	26	31	22	18	11	5	1	2		2	1			1			175
4						1	4	14	12	18	23	22	24	12	12	5	1	4	2	1	1			156
5								1	8	8	9	9	11	4	3	2	4	4	3		1			67
6				1	2		6	16	24	24	33	35	29	12	15	9	4	2	3		2			217
7			1	2	4	11	38	44	40	28	17	9	11	1	1		2		1					210
8		4	3	8	11	12	24	37	20	16	11	10	8	4	2			1	2		1			174
9	1		1	1	2	6	25	47	76	60	44	25	21	18	4	8	7	2	2	4	2		1	357
10						3	3	6	10	10	9	9	13	7	6		2			1				79
11			1	1		11	8	13	14	15	11	7	10	6	6		1	1	1		2			108
12	1	2	2	3	6	3	12	11	11	13	5	8	8	3	3	4	1	2	1	1				100
13					1		3	6	11	10	16	31	35	14	7	8	5	3	2	2				154
14							3	4	16	13	26	38	38	20	9	9	1	2						179
15						1		4	7	14	7	11	10	9	6	8		4		1	1			83
16			1	1	3	2	14	22	50	52	66	56	58	34	35	14	16	11	3		2	1		441
17			1		2	2	5	1	5	13	9	14	11	5	5	4	2	2			1			82
18				1			3	9	17	14	15	28	25	26	7	10	3	2	5	4				169
19				1			1	6	16	15	29	32	56	22	11	8	4	3	4	2	1	1		212
20								1	7	6	5	14	15	9	12	8	1	2	1			2		83
21					4	2	12	23	35	24	35	28	41	18	9	9	3	2		2	1			248
22						1	1	8	15	19	24	24	40	32	27	13	12	7	1	3	3	2		232
23			1			3	9	19	39	32	41	58	71	53	42	17	13	13	3	7	5	1		427
Total	2	8	12	24	45	78	208	347	488	449	483	513	585	331	238	139	89	70	37	30	24	8	1	4,209

Included in above tabulation, 4,209; omitted, not located, or incomplete, 215; total Brooklyn cases, 4,424.

Assembly district.	Cases for week ending—																						Totals.
	May—				June—				July—					August—				September—					Oct.7.	
	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30		
1								1	2	5	6	4	13	12	14	17	3	9	5	4	2	0	0	97
2							2	4	4	15	9	26	30	23	13	9	3	2						140
3							1		5	7	4	10	10	18	8	5	3	3		1				75
4					1	2		2	2	12	11	10	17	15	6	5	6	1		1				91
5	1					1	1		1	3	9	8	13	16	17	16	15	5	1	2		1		110
6						2		1	5	6	9	10	9	12	10	2	4	5	4	3	2	1		85
7							1		1	3	1	9	10	14	9	10	10	10	2	2	3	1		86
8							1	4	6	9	8	14	16	14	5	7	8							92
9										2		1		3	5	8	5	4	1	4	1			34
10						2		1	1	6	5	4	14	7	7	6	8	8	3	3		2		77
11								1	1	3	2	4	6	10	10	12	9	5	3	2	2	1		71
12		1			1			3	8	10	10	21	26	21	28	19	12	5	3	1		2		171
13										1	4	4	12	15	18	19	13	8	8	3	1			106
14								1	1	3	3	10	11	10	5	7	15	7	4	1		2	1	81
15								1	1		1	4	10	8	9	10	4		2	1	1	1		53
16							1		1	1		2	6	4	7	6	6	5	5	3	5	4	2	58
17					1				3		1	5	4	7	10	3	3	2	2	3	7	3		54
18										2	3	9	7	12	9	4	16	9	2	2		3		78
19									1	2	2	4	9	15	10	18	17	14	5	4	5	2	1	109
20								1	1	1	1	8	5	7	10	8	2	9	7	10	4	3	2	79
21							1		1		3	2	5	9	5	6	4	7	2	7	2	1		55
22										1			3	3	4	7	8	3	8	1	4			42
23				1				1		3	3	10	15	22	22	15	9	6	7	1	4	3	1	123
24					1	1			2	10	6	7	14	11	16	11	11	7	3	1		5	2	108
25								1	1	2	5	7	8	8	15	10	6	5	3					71
26									2	7	3	4	9	13	10	14	10	5	6	3	2			88
27											2	1	3	2	6	5	5	1	1	1	1			28
28						2			2	4	4	4	11	7	14	16	10	9	7	4		1		95
29				1				1	2	4	1		4	7	6	2	2	4	2		2	1		39
30								1	2	2	3	6	8	9	20	8	7	9	6	4	4	1		90
31					1					2	3	2	8	3	9	6	2	4	3	4	2	1		50
Total	1	1	0	2	5	10	8	24	56	126	122	210	316	337	337	291	236	171	105	76	54	39	9	2,536

Included in above tabulation, 2,536; not located, omitted, and defective, 136; total Manhattan cases, 2,672.

TABLE F.—*Poliomyelitis, Brooklyn, 1916—Radial spread in Brooklyn from the first epidemic focus—Number of cases each week in successive concentric zones from Fourth Avenue and Carroll Street.*

[Zones 1 mile in width.]

Zones.	Population.	May.				June.				July.					August.				September.					October.		Total cases in zone.	Case rate per 100,000.	Date of occurrence of median case.
		6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14			
No. 1, 0 to 1 mile from center	198,014	0	1	6	5	12	21	26	55	80	73	58	37	37	27	12	7	5	5	4	5	2	1	0	0	479	241.9	July 5
No. 2, 1 to 2 miles from center	277,671	0	0	2	3	7	10	37	66	93	84	80	62	57	76	31	27	8	9	8	3	5	2	2	0	672	242.0	July 11
No. 3, 2 to 3 miles from center	254,435	0	0	0	2	4	8	7	46	76	147	130	145	151	160	95	54	39	14	8	12	7	7	0	1	1,113	253.1	July 22
No. 4, 3 to 4 miles from center	473,653	0	0	0	1	1	4	5	26	62	104	116	148	162	187	96	65	48	26	29	10	7	8	1	1	1,107	233.7	July 25
No. 5, 4 to 5 miles from center	254,435	0	1	0	1	0	2	4	12	28	41	52	60	57	69	61	43	23	19	11	5	8	6	2	0	505	198.5	July 29
No. 6, 5 to 6 miles from center	154,879	0	0	0	0	0	1	1	4	7	23	30	33	52	62	33	48	16	15	9	4	2	2	1	0	343	221.4	Aug. 1
Total	....	0	2	8	12	24	46	80	209	346	472	466	485	516	581	328	244	139	88	69	39	31	26	6	2	4,219	....	

TABLE G.—*Poliomyelitis, New York City, 1916—Radial spread in greater New York from original epidemic focus in Brooklyn—Number of cases each week in successive concentric zones from a center at the intersection of Third Avenue and Carroll Street, Brooklyn.*

Zones.	Population	May.				June.				July.					August.				September.					October.		Total in zone.	Case rate per 100,000.	Date of occurrence of median case.
		6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14			
No. 1, 0 to 1 mile from center	198,014	0	1	6	5	12	21	26	55	80	73	58	37	37	27	12	7	5	5	4	5	2	1	0	0	479	241.9	July 5
No. 2, 1 to 2 miles from center	277,671	0	0	2	3	7	10	37	66	93	84	80	62	57	76	31	27	8	9	8	3	5	2	2	0	672	242.0	July 11
No. 3, 2 to 3 miles from center	771,636	0	0	0	2	5	11	10	57	90	191	166	207	220	226	131	81	59	22	9	15	7	7	0	1	1,517	196.7	July 22
No. 4, 3 to 4 miles from center	810,532	0	0	0	1	1	7	7	30	80	129	142	186	225	246	161	105	82	55	45	21	11	13	1	1	1,549	191.4	July 28
No. 5, 4 to 5 miles from center	414,143	1	1	1	1	1	3	4	15	33	53	71	91	103	116	98	88	60	35	17	9	10	10	3	0	824	198.9	July 31
No. 6, 5 to 10 miles from center	1,821,359	0	0	1	1	6	6	13	21	65	156	227	286	384	482	397	359	233	185	128	92	69	44	19	0	3,174	174.3	Aug. 4
No. 7, 10 to 20 miles from center	733,866	0	0	0	1	0	0	0	12	8	24	31	64	68	100	116	96	59	56	31	23	23	15	12	0	739	100.8	Aug. 9
Total	5,047,221	1	2	10	14	32	58	97	256	449	710	775	933	1,094	1,273	946	763	506	367	242	168	127	92	37	2	8,954	....	

TABLE H.—*Poliomyelitis, New York City, 1916—Age distribution of cases and number of cases, by boroughs and for the city.*

Age in years.	Manhattan.	Bronx.	Brooklyn.	Queens.	Richmond.	The city.
Under 1	351	64	469	110	20	1,014
1	561	111	929	214	42	1,857
2	592	144	1,005	248	73	2,062
3	374	110	710	209	48	1,451
4	206	84	397	129	31	847
5	151	44	276	102	34	607
6	102	28	151	65	14	360
7	60	20	110	45	6	241
8	40	22	61	26	8	157
9	26	12	55	23	2	118
10	18	6	32	21	3	80
11	5	3	24	10	3	45
12	7	1	13	8	2	31
13	9	3	11	6	2	31
14	12	3	18	5	0	38
15	9	4	13	4	2	32
16	3	1	3	3	1	11
17	5	0	5	1	1	12
18	4	3	6	0	0	13
19	6	2	2	0	0	10
20	2	2	0	1	0	5
21	2	0	3	0	0	5
22	4	0	4	1	0	9
23	3	0	2	0	0	5
24	4	0	2	1	0	7
25	1	0	4	1	1	7
26	5	1	5	0	0	11
27	3	1	2	0	0	6
28	7	0	2	0	0	9
29	2	1	5	1	0	9
30	3	0	2	0	1	6
31	2	1	0	0	0	3
32	1	0	2	0	0	3
33	1	0	3	0	0	4
34	0	0	1	0	0	1
35	2	0	1	1	0	4
36	0	0	0	0	0	0
37	1	0	2	0	0	3
38	2	0	1	1	0	4
39	0	1	0	0	0	1
40	1	0	2	0	0	3
42	1	0	0	0	0	1
44	0	0	1	0	0	1
46	0	0	2	1	0	3
47	1	0	0	0	0	1
48	1	0	0	0	0	1
49	1	0	0	0	0	1
58	0	0	1	0	0	1
Total	2,591	672	4,337	1,237	294	9,131

TABLE I.—*Poliomyelitis, New York City, 1916—Number of cases and percentage of total in each age group, by boroughs and for the city.*

	Years in age.																					Total.
	Under 1.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Over 20.	
Manhattan	351	561	592	374	206	151	102	60	40	26	18	5	7	9	12	9	3	5	4	6	50	2,591
Per cent	13.5	21.7	22.8	14.4	8.0	5.8	3.9	2.3	1.5	1.0	0.7	0.2	0.3	0.4	0.5	0.4	0.1	0.2	0.2	0.2	1.9	....
Bronx	64	111	144	110	84	44	28	20	22	12	6	3	1	3	3	4	1	0	3	2	7	672
Per cent	9.5	16.5	21.4	16.4	12.5	6.5	4.2	3.0	3.3	1.8	0.9	0.4	0.1	0.4	0.4	0.6	0.1	0.0	0.4	0.3	1.1	....
Brooklyn	469	929	1,005	710	397	276	151	110	61	55	32	24	13	11	18	13	3	5	6	2	47	4,337
Per cent	10.8	21.4	23.2	16.4	9.2	6.4	3.5	2.5	1.4	1.3	0.8	0.6	0.3	0.2	0.4	0.3	0.05	0.1	0.1	0.03	1.1	....
Queens	110	214	248	209	129	102	65	45	26	23	21	10	8	6	5	4	3	1	0	0	8	1,237
Per cent	8.9	17.3	20.1	16.9	10.4	8.3	5.3	3.6	2.1	1.9	1.7	0.8	0.6	0.5	0.4	0.3	0.2	0.1	0.0	0.0	0.6	....
Richmond	20	42	73	48	31	34	14	6	8	2	3	3	2	2	0	2	1	1	0	0	2	294
Per cent	6.8	14.3	24.8	16.3	10.6	11.6	4.8	2.0	2.7	0.7	1.0	1.0	0.7	0.7	0.0	0.7	0.3	0.3	0.0	0.0	0.7	....
The city	1,014	1,857	2,062	1,451	847	607	360	241	157	118	80	45	31	31	38	32	11	12	13	10	114	9,131
Per cent	11.1	20.3	22.6	15.9	9.3	6.7	3.9	2.6	1.7	1.3	0.9	0.5	0.3	0.3	0.4	0.4	0.1	0.1	0.1	0.1	1.3	....

TABLE J.—*Poliomyelitis, New York City, 1916—Incidence of poliomyelitis per 100,000 population in each age group, by boroughs and for the city.*

Ages.	Manhattan.			Bronx.			Brooklyn.			Queens.			Richmond.			The city.		
	Estimated population of group.	Cases in group.	Incidence rate per 100,000.	Estimated population.	Cases.	Rate.	Estimated population.	Cases.	Rate.	Estimated population.	Cases.	Rate.	Estimated population.	Cases.	Rate.	Estimated population.[1]	Cases.	Rate.
Under 1 year	49,160	351	714.0	13,780	64	46.5	42,780	469	1,096.0	9,270	110	1,187.0	2,030	20	985.0	117,000	1,014	866.0
1 to 4 years	167,100	1,733	....	52,930	449	....	159,510	3,041	....	35,210	800	....	8,120	194	....	422,900	6,217	1,469.0
Total under 5 years	216,260	2,084	964.0	66,710	513	769.0	202,290	3,510	1,735.0	44,480	910	2,046.0	10,150	214	2,108.0	539,900	7,231	1,339.0
5 to 9 years	178,570	379	212.0	60,650	126	208.0	178,490	653	366.0	41,920	261	623.0	10,120	64	632.0	469,800	1,483	316.0
10 to 14 years	173,880	51	29.3	58,900	16	27.2	169,170	98	57.9	40,570	50	123.0	10,030	10	99.7	452,600	225	49.7
15 to 19 years	206,920	27	13.0	58,750	10	17.0	171,220	29	16.9	38,500	8	20.8	8,780	4	45.6	484,200	78	16.1
20 to 24 years	260,300	15	5.8	63,710	2	3.1	184,770	11	6.0	38,450	3	7.8	9,110	0	0	556,300	31	5.6
25 to 34 years	436,550	25	5.7	117,800	4	3.4	329,220	26	7.9	68,500	2	2.9	16,900	2	11.8	969,000	59	6.1
35 to 44 years	315,890	7	2.2	88,550	1	1.1	255,650	7	2.7	57,140	2	3.5	14,200	0	0	731,400	17	2.3
45 to 64 years	289,350	3	1.0	83,160	0	0	250,320	3	1.2	55,430	1	1.8	14,720	0	0	693,000	7	1.0
65 years and over	54,610	0	0	16,750	0	0	56,980	0	0	11,590	0	0	4,550	0	0	145,000	0	0

[1] Estimates for city based on sums of estimates for boroughs.

Table K.—*Poliomyelitis, New York City, 1916—Variations in age distribution in successive groups of approximately 500 cases each—Number and per cent of cases in each age group for each period.*

BOROUGH OF BROOKLYN.

	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	Over 10 years.	Summary.	
													Under 6 years.	Over 6 years.
First period, prior to June 28, 520 cases	68	140	139	74	42	26	10	[illegible]	4	1	1	8	489	31
Per cent	13.1	26.9	26.7	14.2	8.1	5.0	1.9	1.4	0.8	0.2	0.2	1.5	94.0	6.0
Second period, June 28 to July 5, inclusive, 488 cases	51	105	117	82	43	41	15	11	3	4	1	15	439	49
Per cent	10.4	21.5	24.0	16.8	8.8	8.4	3.1	2.3	0.6	0.8	0.2	3.1	90.0	10.0
Third period, July 5 to 12, inclusive, 474 cases	48	94	105	90	44	32	21	12	4	6	5	13	413	61
Per cent	10.1	19.8	22.2	19.0	9.3	6.8	4.4	2.5	0.8	1.3	1.1	2.7	87.1	12.9
Fourth period, July 13 to 19, inclusive, 476 cases	48	100	114	73	42	34	20	13	12	5	1	14	411	65
Per cent	10.1	21.0	24.0	15.3	8.8	7.1	4.2	2.7	2.5	1.1	0.2	3.0	86.3	13.7
Fifth period, July 20 to 25, inclusive, 469 cases	50	93	112	81	41	31	21	11	8	7	6	8	408	61
Per cent	10.7	19.8	23.9	17.3	8.7	6.6	4.5	2.3	1.7	1.5	1.3	1.7	87.0	13.0
Sixth period, July 26 to 31, inclusive, 459 cases	56	99	116	81	35	23	15	10	8	2	4	10	410	49
Per cent	12.2	21.6	25.3	17.6	7.6	5.0	3.3	2.2	1.7	0.4	0.9	2.2	89.3	10.7
Seventh period, Aug. 1 to 6, inclusive, 481 cases	43	102	118	77	47	34	17	14	8	7	4	10	421	60
Per cent	8.9	21.2	24.5	16.0	9.8	7.1	3.5	2.9	1.7	1.5	0.8	2.1	87.5	12.5
Eighth period, Aug. 7 to 18, inclusive, 509 cases	62	97	96	90	52	30	16	14	3	16	8	25	427	82
Per cent	12.2	19.1	18.9	17.7	10.8	5.9	3.1	2.7	0.6	3.1	1.6	4.9	83.9	16.1
Ninth period, Aug. 19 to Oct. 30, inclusive, 461 cases	43	99	88	62	51	25	16	16	13	7	2	39	368	93
Per cent	9.3	21.5	19.1	13.4	11.1	5.4	3.5	3.5	2.8	1.5	0.4	8.5	79.8	20.2

TABLE K.—*Poliomyelitis, New York City, 1916—Variations in age distribution in successive groups of approximately 500 cases each—Number and per cent of cases in each age group for each period*—Continued.

BOROUGH OF MANHATTAN.

	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	Over 10 years. mmemm	Summary.	
													Under 6 years.	Over 6 years.
First period, May 6 to July 22, inclusive, 531 cases	74	129	139	79	39	24	11	12	6	3	3	12	484	47
Per cent	13.9	24.3	26.2	14.9	7.3	4.5	2.1	2.3	1.1	0.6	0.6	2.2	91.2	8.8
Second period, July 23 to Aug. 2, inclusive, 530 cases	80	114	132	77	36	26	17	8	7	6	2	25	465	65
Per cent	15.1	21.5	24.9	14.5	6.8	4.9	3.2	1.5	1.3	1.1	0.4	4.7	87.7	12.3
Third period, Aug. 3 to 13, inclusive, 517 cases	67	113	103	74	47	35	20	14	13	6	3	22	439	78
Per cent	13.0	21.8	19.9	14.3	9.1	6.8	3.9	2.7	2.5	1.2	0.6	4.2	84.9	15.1
Fourth period, Aug. 14 to 26, inclusive, 506 cases	65	97	108	68	50	31	29	11	8	2	3	34	419	87
Per cent	12.8	19.2	21.4	13.4	9.9	6.1	5.7	2.2	1.6	0.4	0.6	6.7	82.8	17.2
Fifth period, Aug. 27 to Oct. 30, inclusive, 507 cases	65	108	110	76	34	35	25	15	6	9	7	17	428	79
Per cent	12.8	21.3	21.7	15.0	6.7	6.9	4.9	3.0	1.2	1.8	1.4	3.4	84.4	15.6

Table L.—*Poliomyelitis, New York City, 1916—Sex distribution of cases by age periods—Number of cases, male and female, with ratio males to females at each age.*

	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years.
Males	557	1,073	1,175	795	469	332	203	121	84	69	41	19	17	18	24
Females	444	771	864	635	365	262	150	115	71	48	36	26	14	13	14
Sex not known	13	13	23	21	13	13	7	5	2	1	3	....	....	....	....
Both sexes	1,014	1,857	2,062	1,451	847	607	360	241	157	118	80	45	31	31	38
Ratio males to females	1.25	1.39	1.36	1.25	1.28	1.27	1.35	1.05	1.18	1.44	1.14	0.73	1.21	1.38	1.71

	15 years.	16 years.	17 years.	18 years.	19 years.	20 to 24 years.	25 to 29 years.	30 to 34 years.	35 to 39 years.	40 to 44 years.	45 to 49 years.	50 to 59 years.	Unknown age.	All ages.
Males	12	5	8	12	3	19	26	11	6	3	3	1	....	5,106
Females	19	6	4	1	7	11	16	6	6	2	3	....	....	3,909
Sex not known	1	....	....	....	....	1	....	....	....	....	....	....	214	330
Both sexes	32	11	12	13	10	31	42	17	12	5	6	1	214	9,345
Ratio males to females	0.63	0.83	2.00	2.00	0.43	1.73	1.62	1.83	1.00	1.50	1.00	....	....	1.31

TABLE M.—*Sex distribution of common communicable diseases, Pennsylvania, 1907–1912.*

Years.	Typhoid fever.				Diphtheria.				Scarlet fever.			
	Total cases.	Males.	Females.	Ratio males to females.	Total cases.	Males.	Females.	Ratio males to females.	Total cases.	Males.	Females.	Ratio males to females.
1907	19,955	11,641	8,314	1.40	10,510	5,015	5,495	0.91	7,699	3,612	4,087	0.88
1908	15,157	8,589	6,568	1.31	12,509	5,846	6,663	.88	14,413	6,702	7,711	.87
1909	11,842	6,759	5,083	1.33	13,133	6,267	6,866	.91	15,563	7,440	8,096	.92
1910	13,835	8,143	5,692	1.43	14,061	6,751	7,310	.92	12,981	6,056	6,925	.87
1911	11,803	6,830	4,973	1.37	16,096	7,744	8,352	.93	10,382	4,876	5,506	.89
1912	9,676	5,582	4,094	1.36	16,617	7,978	8,639	.92	10,963	5,216	5,747	.91
Total, 6 years	82,268	47,544	34,724		82,926	39,601	43,325		71,974	33,902	38,072	
Annual average		7.924	5,787			6,600	7,221			5,650	6,345	
Rate per 100,000, each sex		201.0	155.4	1.29		167.4	194.0	.86		143.3	170.4	.84

[1] Population 1910: Males, 3,942,206; females, 3,722,905; total, 7,665,111.

Table N.—*Poliomyelitis, New York City, 1916—Case fatality by weeks, by boroughs and for the city—Number of cases having onset each week, number of these terminating fatally, and per cent fatality.*

Weeks.	Manhattan.			Bronx.			Brooklyn.			Queens.			Richmond.			The city.		
	Cases.	Fatalities.	Per cent case fatality.	Cases.	Fatalities.	Per cent case fatality.	Cases.	Fatalities.	Per cent case fatality.	Cases.	Fatalities.	Per cent case fatality.	Cases.	Fatalities.	Per cent case fatality.	Cases.	Fatalities.	Per cent case fatality.
May 13	1						2									3		
20							8	1	12.5	1						9	2	22.2
27	2						12	1	8.3							14	1	7.1
June 3	6	1	16.7				25			1			2			34	1	2.9
10	10						45	2	4.4				2			57	2	3.5
17	6						84	13	15.5	1			8	2	25.0	99	15	15.2
24	19	5	26.3	3			210	43	20.5	5			7			244	48	19.7
July 1	53	10	18.9	9	2	22.2	356	92	25.9	12	6	50.0	26	6	23.1	456	116	25.4
8	125	19	15.2	24	7	29.2	493	109	22.1	54	14	25.9	33	4	12.1	729	153	21.0
15	124	30	24.2	33	10	30.3	480	131	27.3	100	26	26.0	56	9	16.1	793	206	26.0
22	206	51	24.8	53	12	22.6	507	127	25.0	124	33	26.6	55	14	25.5	945	237	25.1
29	330	83	25.2	51	9	17.6	535	140	26.2	164	36	22.0	39	5	12.8	1,119	273	24.4
Aug. 5	349	87	24.9	85	20	23.5	621	175	28.2	248	68	27.4	16	5	31.2	1,319	355	26.9
12	347	100	28.8	97	17	17.5	344	82	23.8	164	42	25.6	19	5	26.3	971	246	25.3
19	311	77	24.8	80	17	21.2	261	64	24.5	131	31	23.7	13	2	15.4	796	191	24.0
26	261	58	22.2	51	12	23.5	144	40	27.8	76	17	22.4	4			536	127	23.7
Sept. 2	176	36	20.4	65	12	18.5	95	28	29.5	48	12	25.0	8	2	25.0	392	90	23.0
9	108	29	26.8	30	4	13.3	74	13	17.6	37	6	16.2	4	2	50.0	253	54	21.3
16	79	7	8.9	31	2	6.4	45	4	8.9	28	4	14.3				183	17	9.3
23	53	15	28.3	31	5	16.1	28			30	2	6.7				142	22	15.5
30	44	3	6.8	19	1	5.3	29	2	6.9	10	3	30.0	4			106	4	8.5
Oct. 7	31	8	25.8	21	3	14.3	11	1	9.1	13	2	15.4				76	14	18.4
14	11	3	27.3	3	4	100.0	9	4	44.4	7						30	11	36.7
21	12	6	50.0	1	3	100.0	3	1	33.3	4	1	25.0				20	11	55.0
28	8	5	62.5	3	1	33.3	3	3	100.0	5	1	20.0				19	10	52.6
Onset not given		23			3			1			5						32	
Total	2,672	656	24.6	690	144	20.9	4,424	1,077	24.4	1,263	310	24.6	296	55	18.9	9,345	2,243	24.0

TABLE O.—*Poliomyelitis, New York City, 1916—Sex and age distribution of fatal cases, by boroughs and for the city.*

Borough and sex.	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years
Manhattan:															
Males	68	76	68	42	26	29	12	11	6	3	0	1	0	0	1
Females	64	55	47	33	14	12	11	6	9	2	5	2	1	2	1
Both sexes	132	[1] 133	115	75	40	41	23	17	15	5	5	3	1	2	2
Bronx:															
Males	9	12	15	13	8	4	4	2	3	2	0	0	0	0	1
Females	11	11	11	9	2	7	3	2	2	2	3	1	0	0	0
Both sexes	20	23	26	22	10	11	7	4	5	4	3	1	0	0	1
Brooklyn:															
Males	98	158	120	93	57	42	30	9	8	9	5	3	3	2	1
Females	62	85	75	72	37	29	21	11	6	8	4	3	1	3	3
Both sexes	160	243	195	165	94	71	51	20	14	17	9	6	4	5	4
Queens:															
Males	28	32	29	28	26	11	4	8	0	3	5	1	0	2	1
Females	12	21	16	17	11	13	7	11	2	2	0	2	1	1	2
Both sexes	40	53	45	45	37	[2] 25	11	19	2	5	5	3	1	3	3
Richmond:															
Males	5	8	5	5	4	3	3	2	0	0	0	1	0	1	0
Females	1	0	10	1	1	2	1	1	0	0	0	0	0	0	0
Both sexes	6	8	15	6	5	5	4	3	0	0	0	1	0	1	0
The city:															
Males	208	286	237	181	121	89	53	32	17	17	10	6	3	5	4
Females	150	172	159	132	65	63	43	31	19	14	12	8	3	6	6
Both sexes	358	[1] 460	396	313	186	[2] 153	96	63	36	31	22	14	6	11	10

Borough and sex.	15 years.	16 years.	17 years.	18 years.	19 years.	20 to 24 years.	25 to 29 years.	30 to 34 years.	35 to 39 years.	40 to 44 years.	45 to 49 years.	50 to 54 years.	Age not given.	Total.
Manhattan:														
Males	1	0	1	2	3	6	6	1	3	1				367
Females	2	0	1	2	1	1	1	1	0	0				273
Both sexes	3	0	2	4	4	7	7	2	3	1	0	0	14	[3] 656
Bronx:														
Males	0	1	0	1	0	0	2	0	0	0				77
Females	1	0	0	0	1	0	0	0	0	0				66
Both sexes	1	1	0	1	1	0	2	0	0	0	0	0	1	[2] 144
Brooklyn:														
Males	0	0	0	1	1	3	2	1	1	1				648
Females	1	0	0	0	2	2	0	2	1	0				428
Both sexes	1	0	0	1	3	5	2	3	2	1	0	0	1	[2] 1,077

Queens:														
Males	0	0	0	0	0	1	0	0	0	0	....	....	....	179
Females	1	1	0	0	0	0	1	0	0	0	....	....	....	121
Both sexes	1	1	0	0	0	1	1	0	0	0	0	0	9	[4] 310
Richmond:														
Males	0	0	0	0	0	0	0	0	0	0	....	....	....	37
Females	0	0	0	0	0	0	1	1	0	0	....	....	....	19
Both sexes	0	0	0	0	0	0	1	1	0	0	0	0	0	56
The city:														
Males	1	1	1	4	4	10	10	2	4	2	....	....	....	1,308
Females	5	1	1	2	4	3	3	4	1	0	....	....	....	907
Both sexes	6	2	2	6	8	13	13	6	5	2	0	0	25	[5] 2,243

[1] Including 2 cases, sex not given.
[2] Including 1 case, sex not given.
[3] Including 16 cases, sex not given.
[4] Including 10 cases, sex not given.
[5] Including 28 cases, sex not given.

TABLE P.—*Poliomyelitis, New York City, 1916—Case fatality by age and sex—Number of cases and deaths and case fatality per cent for each age.*

	Age in years.														
	Under 1	1	2	3	4	5	6	7		9	10	11	12	13	14
Males:															
Cases	557	1,073	1,175	795	469	332	203	121	84	69	41	19	17	18	24
Deaths	208	286	237	181	121	89	53	32	17	17	10	6	3	5	4
Per cent	37.3	26.7	20.6	22.8	25.8	26.8	26.1	26.5	20.2	24.6	24.4	31.6	17.6	27.8	16.7
Females:															
Cases	444	771	864	635	365	262	150	115	71	48	36	26	14	13	14
Deaths	150	172	159	132	65	63	43	31	19	14	12	8	3	6	6
Per cent	33.8	22.3	18.4	20.8	17.8	24.0	28.7	27.0	26.8	29.2	33.3	30.8	21.4	46.2	42.9
Sex unknown:															
Cases	13	13	23	21	13	13	7	5	2	1	3	......	......	......	......
Total:															
Cases	1,014	1,857	2,062	1,451	847	607	360	241	157	118	80	45	31	31	38
Deaths	358	[1]460	396	313	186	153	96	63	36	31	22	14	6	11	10
Per cent	35.3	24.8	19.2	21.6	22.0	25.2	26.7	26.1	22.9	26.3	27.5	31.1	19.4	35.5	26.3

	Age in years.													Age not given.	Total.
	15	16	17	18	19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59		
Males:															
Cases	12	5	8	12	3	19	26	11	6	3	3	......	1	......	5,106
Deaths	1	1	1	4	4	10	10	2	4	2	......	......	......	......	1,308
Per cent	8.3	20	12.5	33.3	100	52.6	38.5	18.2	66.6	66.6	......	......	......	......	25.6
Females:															
Cases	19	6	4	1	7	11	16	6	6	2	3	......	1	......	10 3,909
Deaths	5	1	1	2	4	4	3	3	4	1	......	......	......	......	907
Per cent	26.3	16.6	25.0	100	57.2	36.4	18.8	50.0	66.6	50.0	0	0	0	......	23.2
Sex unknown:															
Cases	1	......	......	......	......	1	......	......	......	......	......	......	......	214 ~~110~~	330
Total:															
Cases	32	11	12	13	10	31	42	17	12	5	6	......	2	214	9,345
Deaths	6	2	2	6	8	13	13	6	5	2	......	......	......	25	2,243
Per cent	18.8	18.2	16.7	46.2	80.0	41.9	31.0	35.3	41.7	40.0	......	......	......	......	24.0

---

[1] Including 2 deaths, sex unknown.

TABLE Q.—*Climatological summary, New York City, May to October, 1916—Daily maximum, minimum, and mean temperatures, and precipitation.*

[Compiled from reports of the United States Weather Bureau.]

Day of month.	May.				June.				July.				August.				September.				October.			
	Temperature.			Pre-cipitation.	Temperature.			Pre-cipitation.	Temperature.			Pre-cipitation.	Temperature.			Pre-cipitation.	Temperature.			Pre-cipitation.	Temperature.			Pre-cipitation.
	Max.	Min.	Mean.		Max.	Min.	Mean.		Max.	Min.	Mean.		Max.	Min.	Mean.		Max.	Min.	Mean.		Max.	Min.	Mean.	
				Inches.				*Inches.*				*Inches.*				*Inches.*				*Inches.*				*Inches.*
1	65	45	55.0	....	78	52	65.0	....	83	64	73.5	....	82	69	75.5	....	85	66	75.5	....	60	41	51.0	....
2	75	54	64.5	T.	76	57	66.5	....	81	66	73.5	0.07	78	66	72.0	....	77	59	68.0	0.01	67	50	58.5	....
3	65	55	60.0	....	67	58	62.5	0.10	81	65	73.0	.10	78	64	71.0	....	72	55	63.5	....	72	54	63.0	....
4	71	52	61.5	0.04	74	54	64.0	....	74	60	68.5	....	83	69	76.0	....	73	58	65.5	....	69	59	64.0	....
5	62	52	57.0	.25	75	59	67.0	.02	67	59	63.0	.09	83	71	77.0	T.	84	63	73.5	....	74	57	65.5	....
6	74	51	62.5	T.	74	58	66.0	....	83	60	71.5	....	90	71	80.5	T.	78	64	71.0	....	77	59	68.0	....
7	67	56	61.5	.17	68	53	60.5	1.27	89	67	78.0	....	88	75	81.5	0.01	84	69	76.5	.19	75	60	67.5	....
8	75	55	65.0	.03	60	55	57.5	.17	89	68	78.5	....	91	73	82.0	.32	89	69	79.0	.05	79	58	68.5	....
9	67	53	60.0	T.	57	54	55.5	.01	76	66	71.0	T.	85	67	76.0	.13	75	63	69.0	.17	84	50	67.0	T.
10	61	47	54.0	....	60	51	55.5	.03	74	64	69.0	.15	68	53	65.5	T.	74	58	66.0	....	54	39	46.5	....
11	76	58	67.0	....	56	51	53.5	.24	85	69	77.0	....	69	61	65.0	.01	70	58	64.0	....	63	42	52.5	....
12	67	52	59.5	....	75	53	69.0	....	89	72	80.5	....	85	66	75.5	.05	70	58	64.0	....	63	52	57.5	....
13	63	52	57.5	....	76	59	67.5	T.	88	70	79.0	.82	73	60	66.5	....	78	58	68.0	....	65	54	59.5	.13
14	60	50	55.0	.02	68	54	61.0	....	79	65	72.0	.01	77	56	66.5	....	85	64	74.5	....	57	43	49.5	....
15	57	48	52.5	.01	57	52	54.5	T.	72	62	67.0	....	80	65	72.5	....	77	65	71.0	1.04	59	41	50.0	T.
16	57	49	53.0	2.11	66	54	60.0	.16	76	62	69.0	....	75	67	71.0	T.	70	57	63.5	....	54	52	58.0	.06
17	58	46	52.0	.21	74	61	67.5	.56	85	68	76.5	.01	87	63	75.0	....	68	55	61.5	....	66	44	55.0	T.
18	58	44	51.0	....	78	62	70.0	T.	81	68	74.5	....	81	68	74.5	....	71	53	62.0	.58	55	39	47.0	....
19	66	44	55.0	.04	74	64	69.0	.87	86	69	77.5	....	83	67	75.0	....	64	49	56.5	.06	66	48	57.0	.44
20	66	52	59.0	....	75	57	66.0	....	80	69	74.5	.22	84	68	76.0	....	73	51	62.0	....	73	65	69.0	....
21	70	48	59.0	....	64	55	59.5	.23	83	68	75.5	.32	90	67	78.5	....	69	55	52.0	....	67	47	57.0	T.
22	65	49	57.0	.02	72	52	62.0	....	80	70	75.0	.41	94	75	84.5	....	71	60	65.5	....	58	42	50.0	....
23	54	49	52.0	.18	74	55	64.5	....	79	71	75.0	.03	90	69	79.5	T.	75	59	67.0	.07	57	44	50.5	....
24	66	52	59.0	T.	74	61	67.5	T.	77	69	73.0	....	77	66	71.5	T.	66	52	59.0	....	61	45	53.0	....
25	77	58	67.5	T.	70	61	65.5	.26	76	70	73.0	.32	84	62	73.0	....	63	51	57.0	T.	59	48	53.5	T.
26	76	59	67.5	....	79	62	70.5	....	81	71	76.0	.57	83	68	75.5	....	72	48	60.0	....	61	48	54.5	....
27	68	55	61.5	.05	75	63	69.0	....	85	72	78.5	.32	84	69	76.5	.04	80	60	70.0	....	55	44	49.5	....
28	77	44	65.5	.33	82	67	74.5	.02	78	69	73.5	....	73	55	64.0	.03	78	64	71.0	....	64	46	54.0	....
29	77	62	69.5	.03	87	62	71.5	....	75	64	69.5	....	71	56	63.5	....	75	51	63.0	.81	58	50	54.0	T.
30	77	62	69.5	T.	76	64	70.0	....	80	63	71.5	....	78	61	69.5	....	58	44	51.0	....	67	57	62.0	T.
31	71	56	63.5	....	......	......	......	....	93	73	83.0	....	83	63	73.0	....	......	......	......	....	......	54	60.5	T.
Monthly mean	67.4	52.2	59.8	....	71.2	57.3	64.2	....	80.8	66.9	73.8	....	81.5	65.8	73.6	....	74.1	57.9	66.0	....	65.0	49.5	57.2	....
Precipitation	......	......	......	3.49	......	......	......	39.4	......	......	......	3.44	......	......	......	.59	......	......	......	2.98	......	......	......	.63

TABLE R.—*Climatological conditions, New York City, May to October, 1916—Monthly summaries of conditions from reports of New York Weather Bureau.*

	Temperature in degrees Fahrenheit.							Precipitation in inches.				Number of days—					Remarks.
	Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.	Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall netted.	With precipitation 0.01 inch or more.	Clear.	Partly cloudy.	Cloudy.	Prevailing direction of wind.	
May	59.8	+0.5	77	29	44	18	23	3.49	+0.31	2.28	0	14	4	13	13	NW.	Cooler than normal during day. Lack of sunshine.
June	64.2	−4.3	82	28	51	10	26	3.94	+0.68	1.34	0	13	4	13	13	NW.	Prolonged rainy weather with excessive cloudiness and low temperature.
July	73.8	+0.3	93	31	59	5	23	3.44	−1.10	0.83	0	14	4	9	18	S.	Moderate temperature and heavy rainfall.
August	73.6	+1.4	94	22	55	28	24	0.59	−3.94	0.32	0	7	12	13	6	S.	Warmest since 1906. Driest since 1907.
September	66.0	−0.5	89	8	44	30	24	2.98	−0.61	1.04	0	9	13	14	3	NW.	No unusual features.
October	57.2	+1.6	84	9	39	10	34	0.63	−3.08	0.44	0	3	15	7	9	NW.	Unusually mild and pleasant.

TABLE S.—*Poliomyelitis, 1916—Incidence by States by weeks.*

States.	Number of cases for week ending—																								No date.	Total.
	June.		July.					August.				September.					October.				November.					
	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	28		
Connecticut			1	8	22	58	68	89	78	86	65	47	89	64	64	15	19	11	15	6	10	4			37	856
Delaware					1				1	3	2	7	3	10	9	14	5	5	12	4	1	1		1		79
District of Columbia					4	3	1	2	3	8	5	2	4	1		8	1									42
Maine								2	7	5	6	11	5	19	7	13	22	6	6	6	7	6				128
Maryland				1	1		1	2	5	3	13	18	11	13	11	31	22	25	23	24	18	9	11	8		250
Massachusetts				5	27	41	30	24	49	63	72	73	104	152	181	160	195	165	181	120	87	60	34	24		1,847
New Jersey			3	60	132	165	316	550	604	571	411	328	229	227	170	144	105	49	30	26	12	8	7	1	16	4,164
New Hampshire																									61	61
New York[1]	5	5	17	69	82	134	263	213	226	426	386	486	442	123	183	232	205	112	127	149						3,885
Rhode Island				7	7	5	12	13	13	16	15	8	21	13	26	19	8	12	8	11	6	2				222
Vermont											6	2	3	1	12	7	5	2	6	11	1			1		57
Total	5	5	21	150	276	406	691	895	986	1,181	981	982	911	623	663	643	587	387	408	357	142	90	52	35	114	11,591

[1] Exclusive of New York City.

TABLE T.—*Poliomyelitis, 1916—Rates by States by weeks.*

State.	June.		July.					August.				September.					October.				November.				No date.	Total incidence.
	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	28		
Connecticut, 1,223,583 [1]	....	....	0.1	0.7	1.8	4.7	5.6	7.4	6.4	7.2	5.3	3.9	7.3	5.3	5.3	1.2	1.0	0.9	1.2	0.5	0.8	0.4	....	....	3.0	70.0
Delaware, 211,599 [1]	....	....	....	....	.5	....	....	....	.5	1.4	.9	3.3	1.4	4.7	4.3	6.6	2.4	2.4	5.7	1.9	.5	.5	....	0.5	....	37.3
District of Columbia, 358,679 [1]	....	....	....	....	1.1	.8	.3	.6	.8	2.2	1.4	.6	1.1	.3	....	2.2	.3	....	....	....	....	....	....	....	....	11.7
Maine, 767,638 [1]	....	....	....	....	....	....	....	.15	.9	.7	.8	1.4	.7	2.4	.9	1.7	2.8	.8	.8	.8	.9	.8	....	....	....	16.7
Maryland, 1,351,941 [1]	....	....	....	.08	.08	....	.08	.3	.39	.24	.9	1.2	.8	.9	.8	2.4	1.6	1.9	1.7	1.8	1.2	.7	0.8	.6	....	18.5
Massachusetts, 3, 693,310 [2]	....	....	....	.01	.7	1.19	.8	.7	1.3	.7	2.1	2.1	2.9	4.2	4.9	4.4	5.4	4.5	4.9	3.3	2.5	1.6	.9	.7	....	49.8
New Hampshire, 440,584 [1]	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13.8
New Jersey, 2,844,344 [2]	....	....	.1	2.1	4.6	5.8	11.2	19.4	21.2	20.2	14.4	11.5	8.0	7.9	6.0	5.1	3.7	1.7	1.17	.9	.4	.2	.2	.03	.6	146.4
New York (New York City excepted), 4,640,523 [1]	0.1	0.1	.3	1.4	1.7	2.9	5.7	4.6	4.9	9.2	8.3	10.5	9.5	2.7	3.9	5.0	4.4	2.4	2.7	3.2	....	....	....	....	....	83.5
Rhode Island, 602,764 [1]	....	....	....	1.2	1.2	.8	1.9	2.2	2.2	2.7	2.5	1.3	3.5	2.2	4.2	3.2	1.3	2.0	1.3	1.8	1.0	.3	....	....	....	36.8
Vermont, 362,452 [1]	....	....	....	....	....	....	....	....	....	....	1.7	.6	.8	.3	3.4	1.9	1.4	1.7	3.0	.3	....	....	....	....	....	15.7

[1] United States census estimate, 1915.

[2] State census, 1915.

TABLE U.—*Poliomyelitis, Maine, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Number of cases for week ending—																				Total.	Population, 1915 (estimated).	Rate per 100,000.
	July.				August.				September.					October.				November.					
	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18			
Androscoggin													2				2				4	62,600	6.4
Aroostook						2	2	1													5	81,620	6.1
Cumberland						1	1				1				1	2			1		7	117,670	6.0
Franklin											3										3	19,460	15.4
Hancock														5		1					6	34,740	17.3
Kennebec											2		1		1						4	64,740	6.2
Knox						1	2	5	9	3	11	5	8	16	1	2	2	5	2		72	28,270	255
Lincoln						1											1				2	17,490	11.4
Oxford						1					1		1								3	38,270	7.8
Penobscot										1									1		2	89,800	2.2
Piscataquis						1															1	21,360	4.7
Sagadahoc																							.0
Somerset					1							1			1			1			4	37,530	10.7
Waldo															1				1		2	22,980	8.7
Washington										1	1			1	1		1	1	1		7	41,740	16.8
York					1				2			1	1			1					6	70,350	8.5
Total					2	7	5	6	11	5	19	7	13	22	6	6	6	7	6		128		

TABLE V.—*Poliomyelitis, Massachusetts, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Cases for week ending—																						Total.	1915 population.	Rate per 100,000.
	July.					August.				September.					October.				November.						
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25			
Barnstable	....	....	....	....	1	....	....	1	4	1	....	....	....	1	....	1	....	1	....	....	....	....	10	288,818	34.7
Berkshire	....	....	2	7	3	2	7	9	13	8	16	12	16	7	6	9	14	7	3	1	2	....	144	114,709	125.5
Bristol	....	2	4	7	6	2	3	1	2	3	3	....	1	2	....	4	2	1	2	....	....	....	45	346,964	13.0
Dukes	....	....	....	....	....	....	....	....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	2	4,904	4.1
Essex	....	....	3	....	1	2	3	8	9	11	20	14	19	11	16	14	22	15	8	7	1	2	186	463,662	40.1
Franklin	....	....	2	....	....	2	6	....	2	1	1	1	1	....	....	4	3	0	1	....	....	....	24	48,256	49.7
Hampden	....	....	7	10	4	4	7	6	11	9	22	33	36	24	24	13	9	15	6	12	8	3	263	262,944	100.0
Hampshire	....	....	....	1	....	2	3	2	3	4	2	1	4	1	1	6	5	3	2	....	2	1	43	69,549	61.8
Middlesex	....	1	1	6	2	2	3	13	6	8	7	25	24	38	44	32	42	32	32	14	9	9	350	733,624	47.7
Nantucket	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1	3,166	31.6
Norfolk	....	....	3	1	1	....	....	2	7	3	3	12	11	11	21	23	26	8	4	7	5	3	151	201,907	74.8
Plymouth	....	1	1	1	4	....	....	2	4	1	....	3	2	34	1	....	1	1	1	....	....	....	26	157,303	16.5
Suffolk	....	....	1	2	4	3	11	7	7	16	22	41	58	56	76	54	55	36	26	16	7	6	504	826,801	61.0
Worcester	....	1	3	6	4	5	6	12	4	8	7	10	7	6	6	5	2	1	2	3	....	....	98	430,703	22.8
The State	....	5	27	41	30	24	49	63	72	73	104	152	181	160	195	165	181	120	87	60	34	24	1,847	....	....

TABLE W.—*Poliomyelitis, Connecticut, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Cases for week ending—																						No date.	Total.	Estimated population, 1915.	Case rate.
	July.					August.				September.					October.				November.							
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Fairfield		4	5	12	22	35	26	34	19	10	22	22	11	5	7	1	2			1			10	248	277,557	
Hartford			5	4	3	11	12	16	17	16	21	17	26	4	3	4	10	1	4	3			18	195	277,879	70.2
New Haven	1	2	5	29	35	26	30	23	17	12	20	11	11	2	4	4			4				4	240	371,773	64.5
Middlesex			1			6	4	2			2	3	1	1		1			1				3	25	47,600	52.5
Litchfield			2	4	2	2		4	3	6	1	1	5		2		1	4					2	39	73,596	52.9
New London		2		8	4	7	4	3	6	1	5	3	5	3	2				1					54	95,554	55.4
Tolland			4	1	2	1	1				1	2	2		1									15	27,439	54.5
Windham						1	1	4	3	2	17	5	3			1	2	1						40	49,121	81.4
Total	1	8	22	58	68	89	78	86	65	47	89	64	64	15	19	11	15	6	10	4			37	856		

TABLE X.—*Poliomyelitis, Rhode Island, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Number of cases for week ending—																					Total.	Population, 1915.	Rates per 100,000.
	July.				August.				September.					October.				November.						
	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18				
Bristol	2				2	1	2	1	3	4	1	3	1			1						21	19,955	105.1
Kent			1									2	2			1						6	39,750	15.1
Newport	1	2		3	3	3	2		1	2												17	42,887	39.6
Providence	4	5	4	9	6	9	12	10	4	14	12	18	14	8	11	6	11	6	2			165	474,814	34.8
Washington					2			4		1		3	2		1							13	25,358	51.2
Total	7	7	5	12	13	13	16	15	8	21	13	26	19	8	12	8	11	6	2			222		

TABLE Y.—*Poliomyelitis, Vermont, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Number of cases for week ending—																				Total.	Population, 1915 (estimated).	Rates per 100,000.
	July.				August.				September.					October.				November.					
	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25		
Bennington								3	1		1	2		1								8	21,205	37.7
Caledonia								1					2									3	26,902	11.2
Chittenden												2				1	5				1	9	43,949	20.5
Franklin																	1					1	29,697	33.7
Grand Isle												1	4	2	1	2	4					14	3,404	41.1
Lamoille												1										1	12,743	7.8
Orange												3										3	18,381	16.3
Rutland								1	1	3		2	1	2	1	2	1					14	50,212	27.9
Washington																1						1	44,390	2.3
Windham												1										1	27,070	3.7
Windsor								1										1				2	33,948	5.9
Total								6	2	3	1	12	7	5	2	6	11	1			1	57		

TABLE Z.—*Poliomyelitis, New York State, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Number of cases for week ending—																					Total.	Population, 1915.	Rate per 100,000.
	June.				July.				August.					September.				October.			[2]Nov. 2.			
	1st week.	2d week.	3d week.	4th week.	1st week.	2d week.	3d week.	4th week.	1st week.	2d week.	3d week.	4th week.	5th week.	1st week.	2d week.	14-20.	21-27.	[1] 2.	3-9.	10-16.				
Albany	......	......	......	......	2	......	1	1	......	1	3	......	......	5	1	3	2	3	......	3	8	33	183,330	18.0
Allegany	......	......	......	......	1	......	......	......	1	1	......	......	......	1	......	......	......	3	......	......	......	7	40,216	17.4
Broome	......	......	......	......	......	......	2	......	2	......	......	......	1	1	2	2	1	4	......	......	1	16	90,641	17.6
Cayuga	......	......	......	......	......	......	......	......	......	1	2	3	1	3	3	1	1	1	5	3	4	28	65,751	42.5
Chautauqua	......	......	......	......	......	......	2	1	1	1	4	......	......	......	......	......	1	1	......	......	1	12	116,818	10.3
Chemung	......	......	......	......	......	1	......	......	......	......	1	2	1	......	1	2	......	......	......	2	......	10	59,017	16.9
Chenango	......	......	......	......	......	......	......	......	......	......	......	1	6	6	1	2	2	4	1	4	2	29	36,048	70.1
Columbia	4	1	2	5	6	8	7	11	......	4	1	......	......	8	......	......	......	2	......	......	......	59	44,111	133.9
Courtland	......	......	......	......	......	1	......	......	1	......	1	1	9	5	......	8	5	......	......	1	4	36	30,074	119.7
Delaware	......	......	......	......	......	1	1	6	5	2	7	1	3	28	......	2	3	1	2	......	......	36	45,995	78.3
Dutchess	......	......	......	3	6	4	19	39	20	16	27	27	41	11	1	6	10	3	3	......	1	244	91,044	268.0
Erie	......	......	......	......	......	1	1	......	1	1	......	1	2		2	......	......	......	......	1	......	11	571,897	1.9
Essex	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1	......	1	......	1	4	32,461	12.3
Franklin	......	......	......	......	......	1	......	......	......	......	......	......	......	1	......	......	......	......	......	......	1	3	46,181	6.5
Fulton	......	......	......	......	......	......	1	......	......	......	1	1	......	1	......	......	......	......	......	......	......	4	45,625	8.8
Genesee	......	......	......	......	......	......	1	......	......	......	......	......	......	1	......	......	......	......	1	......	......	3	40,707	7.4
Greene	......	......	......	......	......	2	3	3	3	2	14	6	1	2	......	......	1	1	......	......	......	38	30,091	126.2
Hamilton	......	......	......	......	......	......	......	......	1	......	......	......	......	......	......	......	......	......	......	......	......	1	4,491	22.3
Herkimer	......	......	......	......	......	......	......	......	1	......	......	1	2	2	......	1	1	......	1	1	3	13	64,109	20.3
Jefferson	......	......	......	......	......	......	......	1	1	4	3	7	11	16	3	4	8	4	3	1	8	74	81,009	91.4
Lewis	......	......	......	......	......	1	......	......	......	......	2	......	......	......	......	2	......	2	3	7	1	18	25,947	69.4
Madison	......	......	......	......	......	......	......	......	......	5	7	15	8	6	3	4	7	12	1	6	5	79	41,742	189.3
Monroe	......	......	......	......	......	1	......	......	1	......	2	1	......	......	......	......	......	......	......	4	3	12	31,930	3.8
Montgomery	......	......	......	......	1	......	......	......	......	1	3	10	5	7	3	1	......	2	......	1	2	36	61,030	59.0
Nassau	......	......	2	3	18	23	28	60	38	47	85	62	58	35	20	9	12	4	......	2	3	509	16,825	436.0
Niagara	......	......	......	......	1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	2	108,550	1.8
Oneida	......	......	......	......	......	2	......	5	3	4	16	9	5	7	4	2	3	8	8	4	7	87	167,331	51.9
Ontario	......	......	......	......	......	1	......	......	......	1	......	......	......	......	......	......	......	1	......	......	2	5	54,628	9.1
Onondago	......	......	......	......	......	......	......	2	13	5	26	41	63	66	7	29	27	24	11	11	8	333	213,992	155.8
Orange	......	......	......	......	3	4	7	21	12	12	13	16	20	25	2	15	13	8	5	6	4	186	118,118	157.2
Orleans	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	1	2	33,919	5.9
Oswego	......	......	......	......	......	......	1	......	2	2	18	9	16	14	9	10	21	21	10	16	7	156	75,929	205.0
Otsego	......	......	......	......	1	......	......	1	2	1	1	2	......	4	1	3	11	10	4	1	5	47	48,534	96.7
Putnam	......	......	......	......	......	1	1	1	1	3	2	......	3	......	......	......	......	1	......	......	1	14	12,767	109.7
Rensselaer	......	......	......	......	1	......	1	2	......	......	......	......	4	1	1	4	4	1	......	3	6	28	121,330	23.1

---

[1] Sept. 28 to Oct. 2.

[2] Oct. 17 to Nov. 2.

TABLE Z.—*Poliomyelitis, New York State, 1916—Number of cases by weeks for each county and for the State*—Continued.

Counties.	Number of cases for week ending—																					Total.	Population, 1915.	Rate per 100,000.
	June.				July.				August.					September.				October.			[2]Nov. 2.			
	1st week.	2d week.	3d week.	4th week.	1st week.	2d week.	3d week.	4th week.	1st week.	2d week.	3d week.	4th week.	5th week.	1st week.	2d week.	14-20.	21-27.	[1] 2.	3-9.	10-16.				
Rockland					2		6	4		3	2	1		11		1	8	9	3	1	1	52	46,903	111.0
St. Lawrence								1	1	2	2	6	21	18	12	10	13	6	3	4	5	104	90,291	115.1
Saratoga					1	2	2	2	1	2	2			1		1	1	1		2	2	20	62,982	31.8
Schenectady					1							2				1	1	2			1	8	98,625	8.1
Schoharie								1			1		2	2		1			1			8	23,005	34.8
Schuyler																		1				1	13,954	7.2
Seneca													1	1						1		3	25,249	11.9
Steuben				2	1	1		1		3	7	5	3	4		1		2	1		2	33	83,630	39.4
Suffolk				3	8	9	12	33	30	19	85	90	55	38	20	21	23	10	6	5	6	473	104,342	453.0
Sullivan				1	1	3	8	16	10	11	16	14	13	12	4	4	6	6	1	1	1	128	38,189	336.0
Toiga							1		3		1		1	8	1		1		2	1	1	20	25,549	78.3
Tompkins						1				1		1	5	15	3	2	15	2	5	9	9	68	36,535	186.2
Ulster			1		4	4	9	18	13	13	6	8	11	13		2	5	12	9	8	9	145	85,367	170.0
Warren									2	3		1	6	3		2	1	5	1	2	2	28	32,977	84.9
Washington					1							1	8			2		1	2		1	16	46,955	34.1
Wayne											1	2	4	5		1	1	3	1	2		20	53,476	37.4
Westchester					10	10	19	33	44	54	64	39	94	72	18	24	23	24	18	13	19	578	321,713	180.0
Wyoming							1			1			2	1								5	33,028	15.2
Total	4	1	5	17	69	82	134	263	213	226	426	386	486	442	123	183	232	205	112	127	149			

[1] Sept. 28 to Oct. 2.

[2] Oct. 17 to Nov. 2.

TABLE AA.—*Poliomyelitis, New Jersey, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Cases for week ending—																						Rate unknown.	Total cases.	Population. 1915.	Rate per 100,000.
	July.					August.				September.					October.				November.							
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Atlantic	....	1	2	....	3	1	6	4	12	3	2	2	1	....	....	1	....	....	....	....	....	....	....	37	82,840	44.6
Bergen	....	3	4	4	5	14	23	28	26	11	6	11	8	8	6	4	....	1	1	2	....	....	1	166	178,596	97.9
Burlington	....	....	....	....	2	4	1	3	4	10	4	12	5	7	....	2	....	1	....	2	1	....	....	58	74,737	77.5
Camden	....	....	3	2	2	8	22	23	12	10	12	10	4	4	4	....	....	....	....	....	....	....	....	116	163,221	71.0
Cape May	....	....	....	....	....	....	1	2	4	7	9	3	3	2	1	1	....	....	....	....	....	....	....	33	24,407	135.0
Cumberland	....	....	1	....	1	....	1	1	1	1	5	5	1	5	6	4	2	1	....	....	....	....	....	35	59,481	58.9
Essex	....	20	69	85	182	302	321	278	192	127	74	51	50	23	24	12	8	5	5	....	1	....	4	1,833	566,324	323.0
Gloucester	....	....	1	....	1	2	3	2	1	9	5	1	5	2	2	1	....	1	....	....	....	....	1	37	43,589	84.9
Hudson	3	22	25	38	71	104	82	69	51	29	19	12	10	8	5	3	2	....	....	1	1	....	2	557	571,371	97.5
Hunterdon	....	....	2	2	4	8	3	6	7	3	4	2	....	1	2	....	1	2	....	....	1	....	2	51	34,697	144.2
Mercer	....	....	3	1	1	3	14	8	13	11	11	37	35	38	19	11	8	4	1	....	2	....	3	223	139,812	159.5
Middlesex	....	4	7	12	14	24	33	27	14	14	7	10	5	3	....	1	2	....	1	....	....	....	1	179	144,716	123.9
Monmouth	....	4	4	3	7	21	21	38	23	22	22	15	13	5	2	2	2	....	....	....	....	....	2	206	107,636	191.3
Morris	....	1	7	2	4	19	10	12	10	14	10	13	5	7	8	1	....	2	....	2	....	....	....	127	81,514	155.7
Ocean	....	....	....	....	1	1	3	1	1	4	....	....	1	2	....	....	....	....	1	....	....	....	....	15	23,011	65.2
Passaic	....	3	....	3	5	10	23	15	8	5	6	6	5	5	10	1	....	4	2	....	....	....	....	111	236,364	46.9
Salem	....	....	....	....	....	....	2	5	4	14	8	8	2	4	3	2	2	1	1	....	....	....	....	56	30,292	184.9
Somerset	....	....	2	....	2	6	6	4	3	1	1	2	2	....	1	....	1	....	....	....	....	1	....	32	44,123	72.5
Sussex	....	....	....	....	....	1	2	4	1	1	....	....	....	3	....	....	1	3	....	1	....	....	....	17	25,977	65.5
Union	....	2	3	13	11	20	25	41	24	32	24	26	15	11	6	3	1	....	....	....	1	....	....	258	167,322	154.1
Warren	....	....	....	....	....	2	2	....	....	....	....	1	....	6	6	....	....	....	....	....	....	....	....	17	44,314	38.4
The State	3	60	132	165	316	550	604	571	411	328	229	227	170	144	105	49	30	26	12	8	7	1	16	4,164	....	....

TABLE BB.—*Poliomyelitis, Delaware, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Cases for week ending—																					Total.	Population 1915, estimated.
	July.				August.				September.					October.				November.					
	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25		
Kent	......	......	......	......	......	......	......	......	2	......	3	1	1	......	......	2	......	......	......	......	......	9	32,699
New Castle	......	1	......	......	......	1	2	2	5	3	5	5	11	5	5	6	3	1	1	......	1	57	130,304
Sussex	......	......	......	......	......	......	......	......	......	......	1	2	1	......	......	4	1	......	......	......	......	9	48,596
Not located	......	......	......	......	......	......	1	......	......	......	1	1	1	......	......	......	......	......	......	......	......	4	....
Total	......	1	......	......	......	1	3	2	7	3	10	9	14	5	5	12	4	1	1	......	1	79	....

TABLE CC.—*Poliomyelitis, Maryland, 1916—Number of cases by weeks for each county and for the State.*

Counties.	Cases for week ending—																					Total.	Population, 1915, estimated.
	July.				August.				September.					October.				November.					
	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25		
Allegheny	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	3	......	......	1	1	6	67,010
Anne Arundel	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	2	1	......	......	1	4	39,517
Baltimore	1	1	......	1	2	5	3	13	18	11	13	11	31	21	24	16	12	10	5	5	5	208	723,619
Carroll	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	2	......	2	1	......	6	33,974
Caroline	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	2	1	......	......	3	20,782
Dorchester	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	1	......	2	29,042
Garrett	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	4	5	2	......	1	......	13	21,372
Howard	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	......	......	1	15,784
Kent	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1	15,993
Queen Anne	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	......	......	1	16,033
Talbot	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1	......	1	1	4	19,239
Washington	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	......	......	......	......	......	......	1	51,983
Total	1	1	......	1	2	5	3	13	18	11	13	11	31	22	25	23	24	18	9	11	8	250	....

TABLE DD.—*Poliomyelitis, District of Columbia—Number of cases by weeks.*

	July.					August.				September.					October.				November.				To-tal.	Popula-tion.	Rate.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25			
Washington	....	....	4	3	1	2	3	8	5	2	4	1	......	8	1	......	......	......	......	......	......	......	42	358,679	11.7

TABLE EE.—*Poliomyelitis in cities over 10,000 population, Massachusetts, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	July.					August.				September.					October.				November.				Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25			
Berkshire:																									
Adams					1	1	2	1	1	1	2		1	1				1	1		1		14	14,214	98.5
North Adams				6	2	1	4	6	5	4	2	1	4	1							1		37	22,019	168.2
Pittsfield			1	1			1	2	7	1	9	8	9	5	5	3	9	5					66	38,629	171.1
Bristol:																									
Attleboro																	1						1	19,282	5.2
Fall River	1	2	1	1	1	1	1				1		1	1									11	128,366	8.5
New Bedford	1	1	4	4	1	1				2						1							15	118,158	12.7
North Attleboro											1			1		1			1				4	11,014	36.5
Taunton					1				1		1								1				4	36,283	11.0
Essex:																									
Amesbury							2	2	1	5	5	1	3		2	1						1	23	10,157	22.7
Beverly								1	1		1	5	2		1	2	2	4	1	1			21	21,645	97.4
Gloucester												1					2			1			4	24,398	16.4
Haverhill			1					1	4	1		1	1	2				1					12	48,477	24.7
Lawrence			2			2	1												1				6	100,560	6.0
Lynn									1	1	3	2	1	2	3	5	7	8	3	4	1	1	42	102,425	41.0
Methuen												1			1								2	13,921	14.4
Newburyport										2	5	0	8		3	2	1						21	15,243	138.9
Peabody[1]					1				1	1													3	18,360	16.4
Salem								4	1					1					1				7	48,562	14.4
Franklin:																									
Greenfield			1			1			1				1										4	11,998	33.5
Hampden:																									
Chicopee											1	2	3	2	2		1	1		1		2	15	29,319	51.1
Holyoke			1					2	5	3	6	19	21	12	14	8	3	9	3	6	2		114	65,286	174.2
Springfield			1	4		3	3	3	4	4	13	8	9	8	6	3	3	2	3	4	5		86	105,942	81.2
Westfield			5	3	2	1	1			1	1												14	18,391	76.1
West Springfield					2				1			2	1	1			1						8	10,155	79.2
Hampshire:																									
East Hampton				1			1	2	1	1													6	10,360	58.0
Northampton						1			2	1			1			2	2	1	1		1		12	19,926	60.1
Middlesex:																									
Arlington											1			3				1	3				8	12,811	62.5
Cambridge						1		2	2	1	1	5	5	3	12	6	11	4	7		1	5	66	112,981	58.4
Everett												3	3	4	2	1	5	3	4	1	1		27	39,233	68.9
Framingham									1						1			2					4	13,982	28.6
Lowell		1		1			2		1	2		2		2	1		1	2					15	113,245	13.4
Malden				1				2				1	6	11	3	3	4	5	2	5	1	1	45	51,155	88.1
Marlboro				2																			2	15,187	13.2
Medford									1	1	2	3		4		2	1	1	4				19	26,234	72.5
Melrose														2	7	5	1	1			1		17	17,445	97.5

Natick																		1	1			1	3	10,102	29.7
Newton			1				1	2					3	2	1	2		1	3		1		17	43,715	38.9
Somerville					1			6	1	2	1	4	4		3	3	6	3	4	3	3		44	87,039	50.6
Wakefield												1			2			3	2	3		1	12	12,733	94.3
Waltham												2			8	2	8	3	2		1	1	27	30,570	88.4
Watertown														1			1						2	14,867	13.4
Winchester										1		1	1		1	1		1		1			7	10,603	66.0
Woburn												1				2				1			4	15,969	25.1
Norfolk:																									
Brookline								1			1	2	1			4	5	3	1	1			19	82,730	58.0
Dedham												1	2	2	3	2	5			1	1	1	18	10,433	172.5
Quincy					1							4	5	3	15	12	12	4	3	4	2		65	38,136	170.3
Weymouth												1	1	1	1		1						5	13,882	36.0
Plymouth:																									
Brockton													2						1				3	67,449	4.4
Plymouth					1																		1	13,743	7.3
Suffolk:																									
Boston			1	2	3	3	9	5	7	16	19	37	54	52	76	53	53	36	24	15	6	[1]5	476	756,476	63.0
Chelsea								1			1		3	1			1			1	1		9	46,192	19.5
Revere					1		2	1			1	4	1	2		1	1					1	15	23,136	64.9
Winthrop											1			1					2				4	12,692	31.5
Worcester:																									
Clinton																							0	13,075	0
Fitchburg					1	2	1		1	1				1	1	1			1	1			11	41,781	26.3
Gardner															1				1				2	17,140	11.7
Leominster						1					2			1									4	20,839	19.2
Milford										1	1	1		1									4	14,110	28.3
Southbridge									3	1				1									5	14,205	35.2
Webster				2	1			1										1					5	13,210	37.9
Worcester		1	2	3	2		1	3		3	1	3	1			1	1						23	163,314	14.1

---

[1] No date.

TABLE FF.—*Poliomyelitis in cities over 10,000 population, Connecticut State, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	July.					August.				September.					October.				November.			No date.	Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18				
Fairfield:																									
Bridgeport		4	4	8	7	12	7	9	3	1	8	3	1									4	71	121,579	58.4
Danbury				2	1									1		1				1			6	26,035	23.1
Greenwich				1		9	3	6	6	2	3	7	6	1	3		1						48	19,159	250.5
Norwalk			1		1		2	1	1	1		1										1	9	26,899	33.5
Stamford					10	11	5	14	6	4	10	6	3	1	3		1						74	35,119	210.9
Hartford:																									
Bristol																							0	15,927	0
Endfield						1					2	1	4									6	14	11,618	121.3
Hartford			4	1	2	4	1	4	2	5	6	9	7	2	1	2	4		1	3		2	60	110,900	54.1
Manchester													1	1									2	15,551	12.8
New Briton				1				3	2		2	1	7	1	2	1	5	1	1			1	28	53,794	52.0
Litchfield:																									
Torrington								1					1										2	19,597	10.2
Middlesex:																									
Middletown																						1	1	22,799	4.4
New Haven:																									
Ansonia				1	1	1	3	2														2	10	16,704	59.9
Meriden				2	2	4	3		3	3	2		2										21	34,183	61.4
Naugatuck						1				1			1										3	14,093	21.3
New Haven		1	4	11	17	10	8	10	4	5	6	9	1									1	87	149,685	58.2
Orange				2	2	1	7		3				1			1							17	13,960	121.7
Wallingford						1		1	1		4	1			2	1			3			1	15	12,508	120 0
Waterbury						1	3			1	2		4	2	2	2			1				18	86,973	21.3
New London:																									
New London				2	1							1	2	2	1				1				10	20,985	47.6
Norwich											1												1	29,419	3.4
Windham:																									
Windham							1	1	1	1	16	5	2				1						28	14,154	197.8

TABLE GG.—*Poliomyelitis in cities over 10,000 population, Rhode Island State, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	July.					August.				September.					October.				November.				Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25			
Kent:																									
Warwick	....	....	....	....	....	....	....	....	....	....	....	....	2	2	....	....	1	....	....	....	....	....	5	29,969	16.7
Newport:																									
Newport	....	1	2	....	3	3	3	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	13	30,108	43.3
Providence:																									
Cranston	....	....	....	....	....	1	....	1	2	....	....	2	....	2	....	1	....	....	....	1	....	....	10	25,987	38.6
Cumberland	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	10,848	9.2
East Providence	....	....	....	....	....	....	1	....	1	1	....	....	....	2	....	....	1	....	....	....	....	....	6	18,113	33.1
Pawtucket	....	....	4	....	3	1	1	1	....	....	....	....	....	....	1	2	....	....	....	....	....	....	13	59,411	21.9
Providence	....	4	....	3	6	2	5	5	4	3	12	9	17	10	7	7	4	9	6	....	....	....	113	254,960	44.3
Lincoln	....	....	....	....	....	....	1	1	....	....	2	....	....	....	....	1	....	....	....	....	....	....	5	10,383	48.2
Woonsocket	....	....	....	1	....	2	1	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	8	44,360	18.1

TABLE HH.—*Poliomyelitis in cities over 10,000 population, New York State, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	June.				July.				August.					September.				October.			[1] Nov 2.	Total.	Population.	Rate per 100,000.
	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	14-19	20-26	1-2	3-9	10-16				
Albany:																								
Albany					2									1	1	2	2	1		3	8	20	104,199	1.9
Watervliet														2		1						3	16,546	19.3
Broome:																								
Binghamton							2		2					1				2				7	53,973	12.9
Cayuga:																								
Auburn											1	2	1	1	2						1	8	37,385	21.4
Chautauqua:																								
Dunkirk							1	1	1	1	3											7	20,743	33.7
Chemung:																								
Elmira											1	2	1			1				2		7	38,120	18.4
Columbia:																								
Hudson	4	1	2	4	4	6	5	4		2												32	12,705	252.0
Cortland.																								
Cortland						1							9			7				1		18	13,069	137.7
Dutchess																								
Beacon				3	3	2	8	16	2	2		1	1									38	11,555	329.0
Poughkeepsie					1	1	2	18	11	10	10	10	5	7	1	3			3			82	30,390	270.0
Erie:																								
Buffalo						1	1		1	1		1	2	1	2					1		11	468,558	2.4
Fulton.																								
Gloversville							1															1	22,082	4.5
Johnstown											1	1										2	10,646	18.8
Genessee:																								
Batavia							1												1			2	13,350	15.0
Herkimer:																								
Little Falls												1	1	1								3	13,451	22.3
Jefferson:																								
Wartertown													2									2	29,894	6.7
Montgomery:																								
Amsterdam					1																1	2	37,103	5.4
Monroe:																								
Rochester						1			1			1								3		6	256,417	2.3
Ontario:																								
Geneva						1				1												2	13,711	14.6
Oneida:																								
Rome								1														1	23,737	4.2
Utica						2		2	3	3	15	1	4	2	2		1	3	2			40	85,692	46.7
Onondaga:																								
Syracuse									11	2	18	32	42	39	7	17	15	14	7	5	4	213	155,624	137.0

Orange:																								
Middletown	....	....	....	....	....	....	....	....	....	....	2	1	1	2	....	1	1	2	2	1	1	14	15,810	88.6
Newburgh	....	....	....	....	....	....	....	4	....	....	....	....	....	3	1	2	1	1	....	1	1	14	29,603	47.3
Oswego:																								
Fulton	....	....	....	....	....	....	1	....	....	....	2	....	4	2	....	4	6	7	2	2	1	31	11,908	260.0
Oswego	....	....	....	....	....	....	....	....	1	....	5	2	4	4	7	5	10	5	4	8	4	59	24,101	245.0
Otsego:																								
Oneonta	....	....	....	....	1	....	....	....	....	....	1	1	....	4	....	2	5	9	3	1	3	30	10,962	273.0
Rensselaer:																								
Troy	....	....	....	....	....	....	....	1	....	....	....	....	4	1	....	4	4	....	....	3	3	20	77,916	25.7
Saratoga:																								
Saratoga Springs	....	....	....	....	....	1	1	1	1	1	1	....	....	....	....	....	....	....	....	....	....	6	13,821	43.4
Schenectady:																								
Schenectady	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1	1	2	....	....	1	6	99,519	6.0
St. Lawrence....																								
Ogdensburg	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	16,718	5.9
Steuben:																								
Corning	....	....	....	....	1	1	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	3	15,406	19.5
Hornell	....	....	....	1	....	....	....	....	....	1	1	1	....	....	....	....	....	2	....	....	....	6	14,685	40.9
Tompkins:																								
Ithaca	....	....	....	....	....	1	....	....	....	1	....	1	5	12	1	1	1	....	....	2	3	28	15,848	176.7
Ulster:																								
Kingston	....	....	1	....	1	1	....	1	....	....	....	....	3	....	....	....	....	1	....	....	....	8	26,771	29.9
Warren:																								
Glens Falls	....	....	....	....	....	....	....	....	1	1	....	1	3	1	....	1	1	3	1	2	1	16	16,894	94.7
Westchester:																								
Peekskill	....	....	....	....	....	....	....	....	....	....	1	2	3	1	3	2	4	1	....	1	....	18	18,530	97.1
White Plains	....	....	....	....	....	....	1	....	3	3	1	3	6	10	1	4	1	1	1	1	....	36	22,465	160.0
Mount Vernon	....	....	....	....	1	....	....	4	6	7	5	2	8	4	1	4	2	2	3	6	4	59	37,009	159.0
New Rochelle	....	....	....	....	....	....	9	16	11	13	18	8	18	10	2	2	4	....	....	1	2	114	37,759	302.0
Ossining	....	....	....	....	3	....	....	1	....	2	1	2	....	1	1	....	....	2	1	....	1	15	13,705	109.0
Port Chester	....	....	....	....	....	2	....	....	3	1	10	4	6	1	2	2	1	1	....	....	....	33	16,183	204.0
Yonkers	....	....	....	....	4	4	2	3	3	7	8	5	21	18	3	1	1	5	6	....	5	96	99,838	96.2

---

[1] Sept. 27 to Oct. 2.

[2] Oct. 17 to Nov. 2.

TABLE II.—*Poliomyelitis in cities over 10,000 population, New Jersey State, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	July.					August.				September.					October.				November.			Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18			
Atlantic:																								
Atlantic City	....	1	1	....	3	1	5	1	7	3	1	1	1	....	....	1	....	....	....	....	....	26	57,660	45.3
Bergen:																								
Englewood	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	12,231	0
Garfield	....	....	1	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	14,429	21.6
Hackensack	....	....	1	....	....	....	5	4	2	1	....	1	1	5	1	....	....	....	....	....	....	21	16,945	124.0
Burlington:																								
Burlington	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	2	8,928	22.4
Camden:																								
Camden City	....	....	1	1	....	6	17	12	9	6	7	2	3	1	1	....	....	....	....	....	....	66	106,233	62.2
Gloucester	....	....	2	1	....	....	....	3	1	1	1	....	....	....	1	....	....	....	....	....	....	10	11,109	90.0
Cumberland:																								
Bridgeton	....	....	....	....	....	....	1	....	....	1	1	....	1	2	2	1	....	....	....	....	....	9	14,395	62.6
Millville	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1	....	....	....	....	....	....	2	13,624	14.7
Essex:																								
Belleville	....	1	....	....	2	8	1	1	....	1	4	4	4	3	1	....	....	....	....	....	....	30	12,393	242.1
Bloomfield	....	....	....	1	1	1	2	4	3	5	5	....	1	....	....	....	....	....	....	....	....	23	18,466	124.7
East Orange	....	....	1	3	4	5	3	10	10	4	10	1	4	....	....	....	....	1	1	....	....	57	42,458	134.3
Irvington:																								
Irvington	....	....	2	2	9	20	19	7	5	2	3	1	1	1	1	2	1	....	....	....	....	76	16,039	473.4
Montclair	....	....	1	2	1	1	8	4	....	4	1	....	2	3	....	1	3	2	2	....	....	35	26,318	133.7
Newark City	....	13	56	64	141	233	259	230	150	89	45	38	30	12	17	9	3	1	....	....	....	1,390	408,894	340.1
Orange	....	3	4	9	9	14	11	7	10	11	2	1	2	....	....	....	....	....	....	....	....	83	33,080	251.5
West Orange	....	....	....	1	3	4	3	10	7	5	....	4	2	....	2	....	1	....	....	....	....	42	13,550	310.0
Hudson:																								
Bayonne	....	....	1	....	1	10	14	8	2	3	2	1	....	....	....	....	....	....	....	....	....	42	69,893	60.5
Harrison	....	....	1	1	5	10	8	7	2	....	....	1	....	....	1	....	....	....	....	....	....	36	16,950	212.2
Hoboken	....	1	....	1	4	2	4	2	....	....	....	....	....	....	....	....	....	....	....	....	....	14	77,214	18.2
Jersey City	2	3	7	12	18	30	23	21	23	14	12	5	7	8	3	3	2	....	....	1	1	195	306,345	63.7
Kearny	....	2	....	2	2	5	7	8	7	5	3	3	1	....	....	....	....	....	....	....	....	45	23,539	191.1
Uniontown	....	3	7	8	9	9	3	1	....	1	1	....	....	....	....	....	....	....	....	....	....	42	24,776	169.5
West Hoboken	....	8	1	5	5	4	9	....	4	2	....	....	....	....	....	....	....	....	....	....	....	38	43,139	88.2
West New York	....	....	5	3	9	20	8	8	2	1	....	....	....	....	....	....	....	....	....	....	....	56	18,773	[illegible]98.5
Mercer:																								
Trenton	....	....	3	1	....	1	10	6	11	9	9	33	26	29	16	8	7	3	1	....	....	173	111,593	155.1
Middlesex:																								
New Brunswick	....	....	....	....	1	2	8	9	2	2	1	3	3	1	....	....	....	....	....	....	....	32	25,512	125.5
Perth Amboy	....	2	2	4	4	2	7	1	1	2	2	2	....	....	....	....	....	....	....	....	....	29	41,185	70.4
Monmouth:																								
Asbury Park	....	....	....	1	1	3	3	9	5	1	1	1	1	....	....	....	....	....	....	....	....	26	14,007	185.6
Long Branch	....	....	....	....	1	1	1	2	....	11	4	2	2	....	....	....	....	....	....	....	....	24	15,395	156.1

Morris:																								
Morristown	....	....	....	....	....	1	1	....	2	1	....	....	....	....	1	....	....	....	....	....	....	6	13,284	45.4
Passaic:																								
Passaic	....	....	....	....	1	1	1	2	2	....	....	....	....	....	....	....	....	....	1	....	....	8	71,744	11.2
Paterson	....	2	....	....	1	6	14	7	5	4	4	4	3	3	7	1	....	1	1	....	....	63	138,443	45.6
Union:																								
Elizabeth	....	1	2	....	1	4	6	8	10	14	6	13	4	1	3	2	....	....	....	....	1	76	86,690	87.7
Plainfield	....	....	....	2	3	3	3	12	5	3	5	3	1	3	3	1	....	....	....	....	....	47	23,805	197.5
Rahway	....	....	....	3	....	2	1	5	2	....	5	1	1	....	....	....	1	....	....	....	....	21	10,219	205.8
Warren.																								
Phillipsburg	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	15,605	....

Table JJ.—*Poliomyelitis in cities over 10,000 population, 1916—Number of cases by weeks, total cases, population, and rates.*

DELAWARE.

County and city.	July.					August.				September.					October.				November.				Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	28			
New Castle:																									
Wilmington	....	....	....	....	....	....	....	2	2	5	1	2	4	10	4	5	4	3	1	1	....	1	45	94,265	47.8

DISTRICT OF COLUMBIA.

County and city.	July.					August.				September.					October.				November.				Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	28			
District of Columbia:[1]																									
Washington	....	....	2	3	2	1	3	5	7	3	6	....	1	2	7	....	....	....	....	....	....	....	42	363,980	11.5

[1] One case in March and 1 case in May.

Table KK.—*Poliomyelitis in cities over 10,000 population, Maryland State, 1916—Number of cases by weeks, total cases, population, and rates.*

County and city.	July.					August.				September.					October.				November.				Total.	Population.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	28			
Allegany:[1]																									
Cumberland	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	3	....	....	....	....	4	26,074	15.3
Baltimore:[2]																									
Baltimore	....	1	1	....	1	2	5	3	13	18	11	13	11	31	21	24	14	9	10	3	5	4	200	589,621	33.9
Frederick																									
Frederick	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	11,112	0
Washington:																									
Hagerstown	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	25,679	3.9

[1] Cases tabulated by date of report.

[2] Two cases occurred in Baltimore in March and 2 in December.

TABLE LL.—*Poliomyelitis, Northeastern United States, 1916—Incidence in cities grouped according to population.*

State.	Metropolitan.			Cities 100,000.			Cities 50,000 to 100,000.			Cities 25,000 to 50,000.			Cities 10,000 to 25,000.			Rural.		
	Population.	Cases.	Rate.	Population.	Cases.	Rate.	Population.	Cases.	Rate.	Population.	Cases.	Rate.	Population.	Cases.	Rate.	Population.	Cases.	Rate.
Connecticut	....	....	......	374,498	218	58.2	136,948	46	33.6	110,880	102	92.0	164,820	103	62.5	436,437	387	88.6
Massachusetts[1]	1,660,789	995	59.9	608,005	153	25.2	218,363	124	58.1	195,012	110	56.4	339,484	193	56.9	676,657	261	38.6
New Jersey	1,519,507	2,500	164.5	103,190	176	170.6	51,667	26	50.3	30,019	32	106.6	224,671	292	130.0	915,288	1,138	124.3
New York	5,346,311	10,181	190.4	956,367	250	26.1	290,126	73	25.2	326,182	182	55.8	458,140	346	75.5	2,310,618	2,198	95.1
Rhode Island	440,210	148	33.6	....	....	......	....	....	......	72,986	21	28.8	....	....	......	89,569	53	59.2
Total	8,967,817	13,824	154.2	2,042,060	797	39.0	692,104	269	38.9	735,079	447	60.8	1,187,115	934	78.7	4,428,569	4,037	91.2

[1] Eleven cases in Massachusetts included in table of incidence by weeks by counties omitted from this table; exact location unknown.

TABLE MM.—*Poliomyelitis, 1916—Incidence by weeks outside of New York City in concentric zones 50 miles in width, with Brooklyn as a center.*

Zone.	Total population.	Total cases.	Incidence per 100,000.	Date of mid-case.	Number of cases for week ending— July— 10	17	24	1	8	15	22	29	August— 5	12	19	26	September— 2	9	16	23	30	October— 7	14	21	28	November— 4	11	18	28	No date.
1	3,296,677	5,820	176.5	Aug. 17	....	2	3	10	104	178	248	480	692	727	815	599	510	387	267	229	196	146	71	55	56	10	7	6	1	21
2	1,417,160	1,296	91.5	Aug. 22	....	....	1	5	14	29	75	122	106	123	127	116	135	110	63	71	49	42	26	20	18	10	5	1	1	7
3	1,591,880	1,054	66.2	Sept. 11	4	1	2	5	14	26	43	39	33	39	63	61	67	118	86	101	85	71	49	51	51	14	14	12	5	0
4	5,897,338	2,591	43.9	Sept. 22	....	....	....	1	14	33	31	45	50	68	123	161	185	215	159	229	230	259	197	218	170	92	57	31	23	0
5	1,328,415	384	28.9	Sept. 17	....	....	....	2	2	7	4	2	8	14	38	27	34	38	14	22	35	42	29	38	22	3	2	1	....	0
6	2,521,808	385	15.3	Sept. 14	....	....	....	....	1	3	5	3	7	16	16	22	47	43	36	25	41	35	14	21	36	7	6	....	1	0

COUNTIES INCLUDED IN THE ZONE CLASSIFICATION.

Zone I.—0 to 50 miles.

New York: Nassau, Orange, Putnam, Rockland, Suffolk, Westchester.
New Jersey: Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union.
Connecticut: Fairfield.

Zone II.—50 to 100 miles.

New York: Dutchess, Sullivan, Ulster.
New Jersey: Atlantic, Burlington, Camden, Gloucester, Ocean, Warren.
Connecticut: Hartford, Litchfield, Middlesex, New Haven.

Zone III.—100 to 150 miles.

New York: Albany, Broome, Columbia, Delaware, Greene, Otsego, Rennslaer, Schoharie.
New Jersey: Cape May, Cumberland, Salem.
Massachusetts: Berkshire, Hampshire, Hampden.
Delaware: New Castle, Kent.
Rhode Island: Bristol, Kent, Washington.
Connecticut: New London, Tolland, Windham.
Maryland: Cecil.

Zone IV.—150 to 200 miles.

New York: Chemung, Chenango, Cortland, Fulton, Herkimer, Madison, Montgomery, Oneida, Onondaga, Schenectady, Schuyler, Saratoga, Tioga, Tompkins, Washington.

Zone IV—Continued.

Maryland: Anne Arundel, Baltimore, Carroll, Caroline, Dorchester, Hartford, Howard Kent, Queen Anne, Prince George, Talbot, Wicomico, Worcester.
Vermont: Bennington, Windham.
New Hampshire: Cheshire, Hillsboro.
Rhode Island: Newport, Providence.
Delaware: Sussex.
Massachusetts: Barnstable, Bristol, Dukes, Essex, Franklin, Middlesex, Nantucket, Norfolk, Plymouth, Worcester, Suffolk.

Zone V.—200 to 250 miles.

New York: Allegany, Essex, Hamilton, Lewis, Livingston, Ontario, Oswego, Seneca, Steuben, Warren, Wayne, Yates, Cayuga.
District of Columbia.
Maryland: Allegany, Calvert, Charles, Frederick, Garrett, Montgomery, Somerset, St. Marys, Washington.
Vermont: Addison, Orange, Rutland, Windsor.

Zone VI.—250 miles and over.

New York: Clinton, Chautauqua, Cattaraugus, Erie, Franklin, Genesee, Jefferson, Monroe, Niagara, Orleans, St. Lawrence, Wyoming.
Vermont: Caledonia, Chittenden, Essex, Franklin, Grand Isle, Lamoille, Orleans, Washington.
Maine: Entire State.

TABLE NN.—*Poliomyelitis, Northeastern United States, 1916—Incidence by 50-mile zones outside of New York City, divided according to main routes of travel.*

Zone.	Division I—Connecticut, Massachusetts, Rhode Island, Vermont, and Maine.				Division II—New York.				Division III—New Jersey, Delaware, and Maryland.			
	Cases.	Population.	Rate.	Mid cases.	Cases.	Population.	Rate.	Mid cases.	Cases.	Population.	Rate.	Mid cases.
I	248	277,557	89.4	8/16	1,812	720,668	251.5	8/18	3,760	2,298,452	163.6	8/14
II	499	770,848	64.7	8/27	517	214,600	240.9	8/15	280	431,712	64.9	8/27
III	599	704,379	85.0	9/13	265	587,037	45.1	8/24	190	300,464	63.2	9/17
IV	1,588	3,812,084	41.7	9/29	760	1,004,168	75.7	9/3	243	1,081,086	22.5	3/29
V	19	121,551	15.6	9/23	303	552,023	54.9	9/18	62	654,841	9.5	9/12
VI	157	959,781	16.3	9/27	228	1,562,027	14.6	8/28	....	....	....	....
Total	3,110	6,646,200	....	....	3,885	4,640,523	....	....	4,535	4,766,555	....	....

TABLE OO.—*Hartford County, Conn., 1916—Cases of poliomyelitis in minor civil divisions, by weeks, with population and rates.*

Towns.	July.					August.				September.					October.				November.				No date.	Total cases.	Population, 1915.	Rate per 100,000.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Hartford	1		3	1	3	3	2	3	5	6	7	5	7	1	1	2	4		1	3			2	60	108,969	55.1
New Britain		1			1		1	3	1	1		3	5	1	2	1	5	1	1				1	28	52,203	53.6
Bristol																								0	15,536	0
Manchester													1	1										2	15,243	13.1
Endfield						1				1	1	1	4										6	14	11,312	123.8
East Hartford									1		1		1											3	9,050	33.2
Southington						1		2	2				1											6	6,836	87.8
West Hartford						1	2		1	2	2	1	1						1					11	5,663	194.3
Glastonbury			2		2			1	1														1	7	5,078	137.8
Windsor				1	1		2	2	2	6	1												4	19	4,376	434.2
Windsor Locks				1		2	2	2	1	1	2	1	1											13	4,060	320.2
Suffield							1																1	2	4,010	49.9
Berlin								1	1	2								1						5	3,876	129.0
Farmington						1																		1	3,555	28.1
East Windsor													1			1								2	3,470	57.6
Wethersfield						1																		1	3,418	29.3
Plainville									1															1	3,248	30.8
Simsbury								1	1								1						1	4	2,770	144.4
Canton							1	1																2	2,760	72.5
South Windsor						1							1											2	2,376	84.2
Newington																							1	1	2,031	49.2
Bloomfield									2				1											3	1,984	151.2
Granby									1															1	1,428	70.0
Burlington																								0	1,373	0
Avon							1	1					1											3	1,356	221.2
Rocky Hill																								0	1,273	0
East Granby									1	1		1											1	4	858	466.2
Hartland																								0	519	0
Marlboro																								0	292	0
Total	1	1	5	3	7	11	12	17	21	20	14	12	25	3	3	4	10	2	3	3			18	195		

TABLE PP.—*Middlesex County, N. J., 1916—Cases of poliomyelitis in minor civil divisions, by weeks, with population and rates.*

Towns.	Cases for week ending—																						Un-known.	Total cases.	Population, 1915.	Rate per 100,000.
	July.					August.				September.					October.				November.							
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Perth Amboy		1	3	4	3	5	3	3	1	4		2												29	39,719	73.0
New Brunswick	1					10	5	5	1	2	3	2	3	1										33	30,019	100.8
Woodbridge		1		3		4	1	1	1	3		2											1	17	12,133	140.1
Roosevelt		1		1																				2	8,049	24.8
South Amboy			1				1	3																5	7,482	66.8
South River							1			1														2	6,691	29.9
Sayerville							1		2															3	6,312	47.5
Piscatawney				1			1			2		1				1								6	3,624	165.5
Raritan			1		1	1											1							4	3,412	117.2
South Brunswick				5	6	12	8	4			1			1			1		1					39	2,929	1,331.4
Highland Park							2				1	1		1										5	2,901	177.4
Donellen						1	1		2	3														7	2,877	243.3
Metuchen			2				1																	3	2,692	111.4
Monroe			1	1	1		2	1	1			1												8	2,581	309.9
Madison							1																	1	2,123	47.1
Milltown																								0	1,902	0
Jamesburg						1																		1	1,865	53.6
East Brunswick							1	3	1															5	1,865	258.1
Cranbury						3	1	3	2		1	1	1											12	1,533	782.8
Middlesex											1													1	1,310	76.2
North Brunswick								1																1	1,247	80.2
Helmetta																1								1	767	130.4
Spottswood			1																					1	633	146.4
Total	1	3	9	15	11	37	30	24	11	15	7	10	4	3	0	2	2	....	1	....	....	....	1	186	....	....

TABLE QQ.—*Hunterdon County, N. J., 1916—Cases of poliomyelitis in minor civil divisions, by weeks, with population and rates.*

Civil division.	Cases for week ending—																					Date unknown.	Total cases.	Population, 1915.	Rate per 100,000.
	July.					August.				September.					October.				November.						
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Lambertville city								1	1															2	4,600	43.5
Readington Township		1		1	3	2		1																8	2,648	302.3
Flemington Borough																	1							1	2,635	37.9
Lebanon Township							1	1	3	2	1													8	2,211	361.9
Clinton Township					2	1			1									1				1		6	2,157	278.2
Delaware Township			1	1				1																3	1,941	154.5
Raritan Township														1										1	1,896	52.7
Tewksbury Township									1															1	1,734	57.7
High Bridge Borough					1																			1	1,700	58.8
East Amwell Township				1																				1	1,251	79.9
Kingwood Township																								0	1,241	0.0
Franklin Township					1																			1	1,141	87.6
Alexandria Township															1									1	1,093	91.5
Union Township																								0	1,054	0.0
Frenchtown Borough																								0	983	0.0
Holland Township																								0	975	0.0
Bethlehem Township				1	1	1								1	2									6	975	615.4
West Amwell Township																								0	848	0.0
Hampton Borough							1	1	2		4	1											2	11	843	1,304.8
Clinton Borough																								0	841	0.0
Milford Borough																								0	687	0.0
Bloomsbury Borough																								0	630	0.0
Stockton Borough																								0	613	0.0
Total		1	1	4	8	4	2	5	8	2	1	1		2	3		1	1				1	2	51	34,697	

TABLE RR.—*Warren County, N. J., 1916—Cases of poliomyelitis in minor civil divisions, by weeks, with population and rates.*

Civil divisions.	Cases for week ending—																						Date unknown.	Total cases.	Population, 1915.	Rate per 100,000.
	July.					August.				September.					October.				November.							
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Phillipsburg Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	15,430	0.0
Washington Borough	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	3,250	0.0
Hackettstown Township	...	...	...	...	...	...	...	...	...	...	...	...	...	6	5	...	...	...	...	...	...	...	...	11	2,976	369.6
Alpha Borough	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	2,084	0.0
Oxford Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,975	0.0
Belvidere Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,823	0.0
Harmony Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,465	0.0
Blairstown Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,447	0.0
Franklin Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,310	0.0
White Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,237	0.0
Pohatcong Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,634	0.0
Mansfield Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,217	0.0
Knowlton Township	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	1,192	83.9
Incoponcone Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,151	0.0
Washington Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,078	0.0
Hope Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	1,074	93.1
Greenwich Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	1,014	0.0
Lopatcong Township	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	938	213.2
Frelinghuysen Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	788	0.0
Allamachy Township	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	666	300.3
Harkwick Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	369	0.0
Pehaqwarty Township	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	196	0.0
Total	...	...	...	...	...	2	2	...	...	...	...	1	...	6	6	...	...	...	...	...	...	...	...	17	44,314	...

TABLE SS.—*Sussex County, N. J., 1916—Cases of poliomyelitis in minor civil divisions, by weeks, with population and rates.*

Civil divisions.	Cases for week ending—																					Date unknown.	Total cases.	Population, 1915.	Rate per 100,000.
	July.					August.				September.					October.				November.						
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25				
Newton Township	....	....	....	2	....	2	1	....	....	....	....	....	....	1	....	....	1	2	....	....	....	....	....	9	4,433	203.0
Franklin Borough	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	3,262	0.0
Wantage Township	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2,269	44.1
Hardyston Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	....	....	....	2	2,030	98.5
Vernon Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	1,604	0.0
Sussex Borough	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	1,251	0.0
Sparta Township	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	2	1,170	170.9
Frankford Township	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1,096	182.5
Stanhope Borough	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	1,028	0.0
Stillwater Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	891	0.0
Sandyston Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	796	0.0
Hampton Township	....	....	....	....	....	1	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	2	700	285.7
Lafayette Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	687	0.0
Montague Township	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	630	158.7
Branchville Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	620	0.0
Ogdensburg Borough	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	600	0.0
Andover Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	504	0.0
Greene Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	504	0.0
Andover Borough	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	479	0.0
Byram Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	437	0.0
Fredon Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	448	0.0
Walpack Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	304	0.0
Hopatcong Township	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	234	0.0
Total	....	....	....	2	....	4	1	2	1	1	....	....	....	3	....	....	1	3	....	1	....	....	....	19	25,977	....

TABLE TT.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases in certain States.*

States.	Number of cases at each age.																									
	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years.	15 years.	16 years.	17 years.	18 years.	19 years.	20 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.	Age unknown.	Total.
Connecticut	81	128	119	96	73	55	37	41	28	18	11	9	18	11	15	6	8	6	4	3	12	13	8	1	....	55	856
Massachusetts	136	332	349	235	195	128	89	59	59	28	20	21	15	8	7	11	11	5	7	12	57	18	8	3	1	22	1,836
New Jersey	241	469	514	415	273	201	142	108	75	51	36	33	27	18	15	10	11	16	10	7	55	17	7	....	....	23	[1] 2,774
Rhode Island	22	39	27	20	24	19	10	6	2	6	5	1	3	2	4	1	3	....	....	2	1	....	....	....	....	25	222
Summary	480	968	1,009	766	565	403	278	214	164	103	72	64	63	39	41	28	33	27	21	24	125	48	23	4	1	125	5,683

[1] Age distribution of 1,390 cases New York City not known; omitted.

TABLE UU.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases by States—Number of cases and percentage of total in each age group.*

Age groups.	Connecticut.		Massachusetts.		New Jersey.		Rhode Island.		Combined.	
	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.
Under 1	81	10.1	136	7.5	241	8.8	22	11.2	480	8.6
Total 5	497	62.1	1,247	68.7	1,912	69.5	132	67.0	3,788	68.1
5 to 9	179	22.3	303	20.0	577	21.0	43	21.8	1,162	20.9
10 to 14	64	8.0	71	3.9	129	4.7	15	7.6	279	5.0
15 to 19	27	3.4	46	2.6	54	2.0	6	3.1	133	2.4
20 to 29	12	1.5	57	3.1	55	2.0	1	.5	125	2.2
30 to 39	13	1.6	18	1.0	17	.6	....	....	48	.9
40 to 49	8	1.0	8	.4	7	.2	....	....	23	.4
50 to 59	1	.1	3	.2	....	....	....	....	4	.1
60 to 69	....	....	1	.1	....	....	....	....	1	....
All known ages	801	100.0	1,814	100.0	2,751	100.0	197	100.0	5,563	100.0
Unknown age	55	....	22	....	23	....	25	....	125	....
All ages	856	....	1,836	....	2,774	....	222	....	5,688	....

TABLE VV.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases in metropolitan districts, in groups of cities of various size, and in rural districts.*

I. METROPOLITAN DISTRICTS.

	Cases at each age.																									Age unknown.	Total.
	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years.	15 years.	16 years.	17 years.	18 years.	19 years.	20 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.		
Boston	84	179	211	146	105	65	37	31	25	12	7	12	8	5	4	3	3	1	2	5	24	11	3	1	1	10	995
Providence	16	26	19	15	19	11	5	2	....	2	3	1	....	1	2	....	2	....	....	2	....	....	....	....	....	22	148
New York (outside of New York City)	109	183	211	163	114	62	47	30	12	15	10	14	7	4	2	3	3	5	3	2	14	4	2	....	....	9	1,028
Philadelphia	9	15	18	6	9	8	8	3	2	....	1	....	....	....	....	2	....	1	....	....	....	....	....	....	....	....	82
Total	218	403	459	330	24	146	97	66	39	29	21	27	15	10	8	8	8	7	5	9	38	15	5	1	1	41	2,253
II. CITIES OF 100,000 POPULATION AND OVER.																											
New Jersey	34	41	33	27	11	8	5	3	4	1	1	....	....	....	....	1	1	1	1	....	1	....	2	....	....	1	176
Connecticut	23	37	32	21	31	12	9	8	7	2	2	2	3	....	2	1	2	....	....	2	4	2	....	....	....	16	218
Rhode Island	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Massachusetts	8	33	32	16	18	12	6	7	1	....	2	1	....	1	....	1	1	....	2	1	6	....	....	....	....	5	153
Total for group	65	111	97	64	60	32	20	18	12	3	5	3	3	1	2	3	4	1	3	3	11	2	2	....	....	22	547
III. CITIES OF 50,000 TO 100,000 POPULATION.																											
New Jersey	2	8	6	4	2	1	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26
Connecticut	13	6	5	4	3	2	2	3	....	....	....	1	....	2	....	1	....	....	....	....	1	1	1	....	....	1	46
Rhode Island	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Massachusetts	10	28	30	17	8	8	10	3	1	2	....	....	1	....	....	3	....	....	....	....	3	....	....	....	....	....	124
Total for group	25	42	41	25	13	11	12	9	1	2	....	1	1	2	....	4	....	....	....	....	4	1	1	....	....	1	196

TABLE VV.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases in metropolitan districts, in groups of cities of various size, and in rural districts*—Continued.

	Cases at each age.																									Age unknown.	Total.
	Under 1 year.	1 year.	2 years.	3 years.	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years.	15 years.	16 years.	17 years.	18 years.	19 years.	20 to 29 years.	30 to 39 years.	40 to 49 years.	50 to 59 years.	60 to 69 years.		
IV. CITIES OF 25,000 TO 50,000 POPULATION.																											
New Jersey	2	7	10	5	2	....	1	1	....	1	....	....	....	....	....	....	....	....	....	....	2	1	....	....	....	....	32
Connecticut	9	21	15	21	3	6	6	4	3	2	....	1	1	1	....	2	2	....	....	....	2	....	....	....	....	3	102
Rhode Island	2	2	3	2	1	1	3	1	1	2	1	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....	21
Massachusetts	5	15	19	9	12	7	13	6	7	2	....	2	....	....	....	....	....	....	....	1	7	1	1	....	....	3	110
Total for group	18	45	47	37	18	14	23	12	11	7	1	3	2	1	....	3	2	....	....	1	11	2	1	....	....	6	265
V. CITIES OF 10,000 TO 25,000 POPULATION.																											
New Jersey	20	44	59	55	30	24	13	10	10	6	1	3	3	2	2	1	....	....	2	1	3	....	....	....	....	3	292
Connecticut	10	17	16	13	8	11	6	6	1	3	....	3	....	1	....	....	....	....	....	....	2	1	1	....	....	4	103
Rhode Island	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Massachusetts	14	36	30	24	22	16	9	4	7	4	7	3	1	....	2	2	2	....	1	1	3	1	2	1	....	1	193
Total for group	44	97	105	92	60	51	28	20	18	13	8	9	4	3	4	3	2	....	3	2	8	2	3	1	....	8	588
VI. CITIES OF LESS THAN 10,000 POPULATION AND RURAL DISTRICTS.																											
New Jersey	65	171	177	155	105	98	68	58	47	28	23	16	17	12	11	3	7	9	4	4	35	12	3	....	....	10	1,138
Connecticut	26	47	51	37	28	24	14	20	17	11	9	2	14	7	13	2	4	6	4	1	3	9	6	1	....	31	387
Rhode Island	4	11	5	3	4	7	2	3	1	2	1	....	2	1	2	....	1	....	....	....	1	....	....	....	....	3	35
Massachusetts	15	41	27	23	30	20	14	8	18	8	4	3	5	2	1	2	5	4	2	4	14	5	2	1	....	3	261
Total for group	110	270	260	218	167	149	98	89	83	49	37	21	38	22	27	7	17	19	10	9	53	26	11	2	....	47	1,839

Table WW.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases in certain States, arranged in groups of cities, according to size, showing number and per cent of cases at each age for the different groups of cities.*

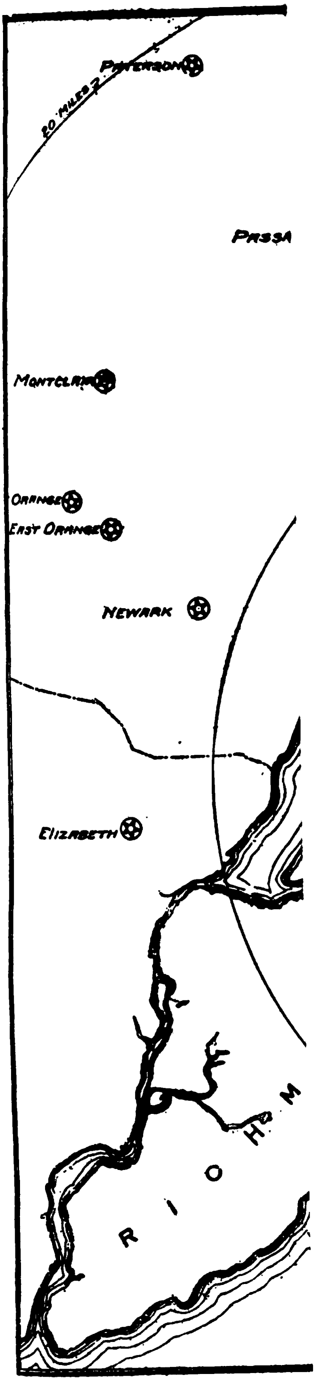
Age groups	Metropolitan districts.		Cities of 100,000 population and over.		Cities of 50,000 to 100,000 population.		Cities of 25,000 to 50,000 population.		Cities of 10,000 to 25,000 population.		Cities of under 10,000 population and rural districts.	
	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.	Cases.	Per cent of total.
Under 1	218	9.9	65	12.4	25	12.8	18	7.0	44	7.6	110	6.1
Total under 5	1,657	74.9	397	75.6	146	74.8	165	63.7	398	68.6	1,025	57.2
5 to 9	377	17.0	85	16.2	35	17.9	67	25.9	130	22.4	468	26.1
10 to 14	81	3.7	14	2.7	4	2.1	7	2.7	28	4.8	145	8.1
15 to 19	37	1.7	14	2.7	4	2.1	6	2.3	10	1.7	62	3.5
20 to 29	38	1.7	11	2.0	4	2.1	11	4.2	8	1.4	53	3.0
30 to 39	15	.7	2	.4	1	.5	2	.8	2	.4	26	1.4
40 to 49	5	.2	2	.4	1	.5	1	.4	3	.5	11	.6
50 and over	2	.1	0	......	0	......	0	......	1	.2	2	.1
All known ages	2,212	100.0	525	100.0	195	100.0	259	100.0	580	100.0	1,792	100.0
Unknown ages	41	......	22	......	1	......	6	......	8	......	47	......
All cases	2,253	......	547	......	196	......	265	......	588	......	1,839	......

Table XX.—*Poliomyelitis, Northeastern United States, 1916—Age distribution of cases, arranged in groups of cities according to size, age groups corresponding to those used by previous authors—Number of cases and per cent of total in each age group.*

Age groups.	Metropolitan.		Cities of 100,000 population and over.		Cities of 50,000 to 100,000 population.		Cities of 25,000 to 50,000 population.		Cities of 10,000 to 25,000 population.		Cities of under 10,000 population and rural. districts.	
	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.	Cases.	Per cent.
Under 1	218	9.9	65	12.4	25	12.8	18	7.0	44	7.6	110	6.1
1 to 5	1,585	71.7	364	69.3	132	67.7	161	62.1	405	69.8	1,064	59.4
6 to 10	252	11.4	58	11.0	24	12.3	54	20.8	87	15.0	356	19.9
11 to 15	68	3.0	12	2.3	8	4.1	9	3.5	23	4.0	115	6.4
16 to 20	29	1.3	11	2.1	0	0	3	1.2	7	1.2	55	3.1
Adults	60	2.7	15	2.9	6	3.1	14	5.4	14	2.4	92	5.1
Total under 6	1,803	81.5	429	81.7	157	80.5	179	69.1	449	77.4	1,174	65.5
Total under 16	2,123	96.0	499	95.0	189	96.9	242	93.4	559	96.4	1,645	91.8
Total	2,212	......	525	......	195	......	259	......	580	......	1,792	......

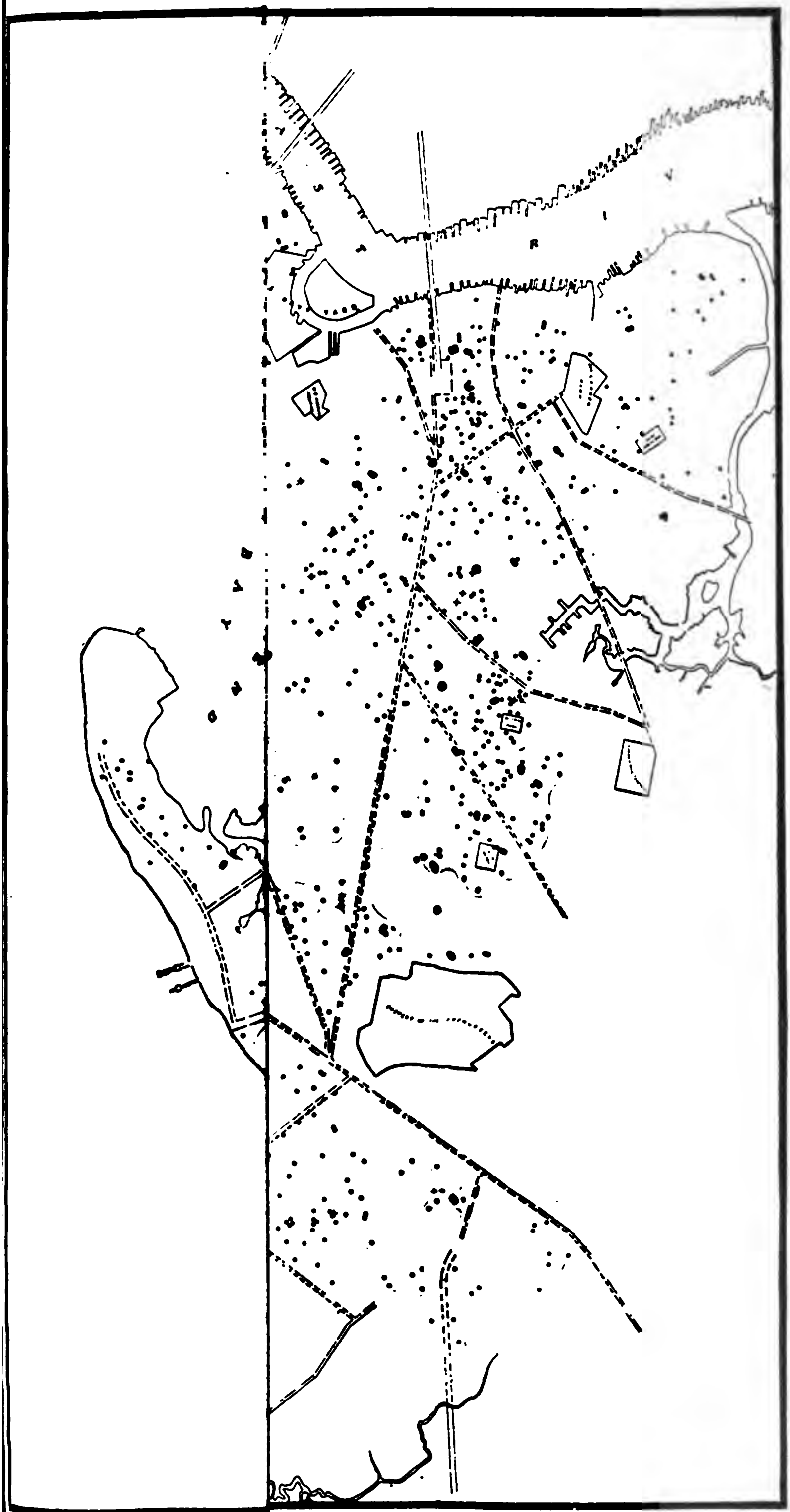
TABLE YY.—*Age distribution of poliomyelitis in various epidemics and in various classes of cities outside of New York City, 1916.*

Age groups.	Percentage of cases in each age group.								
	New York City, 1907.	New York City, 1916.	Metropolitan districts, 1916.	Cities of over 100,000 population, 1916.	Cities of 50,000 to 100,000 population, 1916.	Cities of 25,000 to 50,000 population, 1916.	Cities of 10,000 to 25,000 population, 1916.	Cities of under 10,000 population and rural districts, 1916.	Iowa (rural), 1910.
Age 1	8.5	11.1	9.9	12.4	12.8	7.0	7.6	6.1	4.3
1 to 5	82.0	74.7	71.7	69.3	67.7	62.1	69.8	59.4	48.3
6 to 10	6.4	10.5	11.4	11.0	12.3	20.8	15.0	19.9	21.4
11 to 15	1.9	1.9	3.0	2.3	4.1	3.5	4.0	6.4	10.7
16 to 20	.7	.6	1.3	2.1	0	1.2	1.2	3.1	.75
Adults	.4	1.2	2.7	2.9	3.1	5.4	2.4	5.1	.75
Total under 6	90.5	85.8	81.5	81.7	80.5	69.1	77.4	65.5	52.6
Total under 16	98.8	96.3	96.0	95.0	96.9	93.4	96.4	91.8	84.7



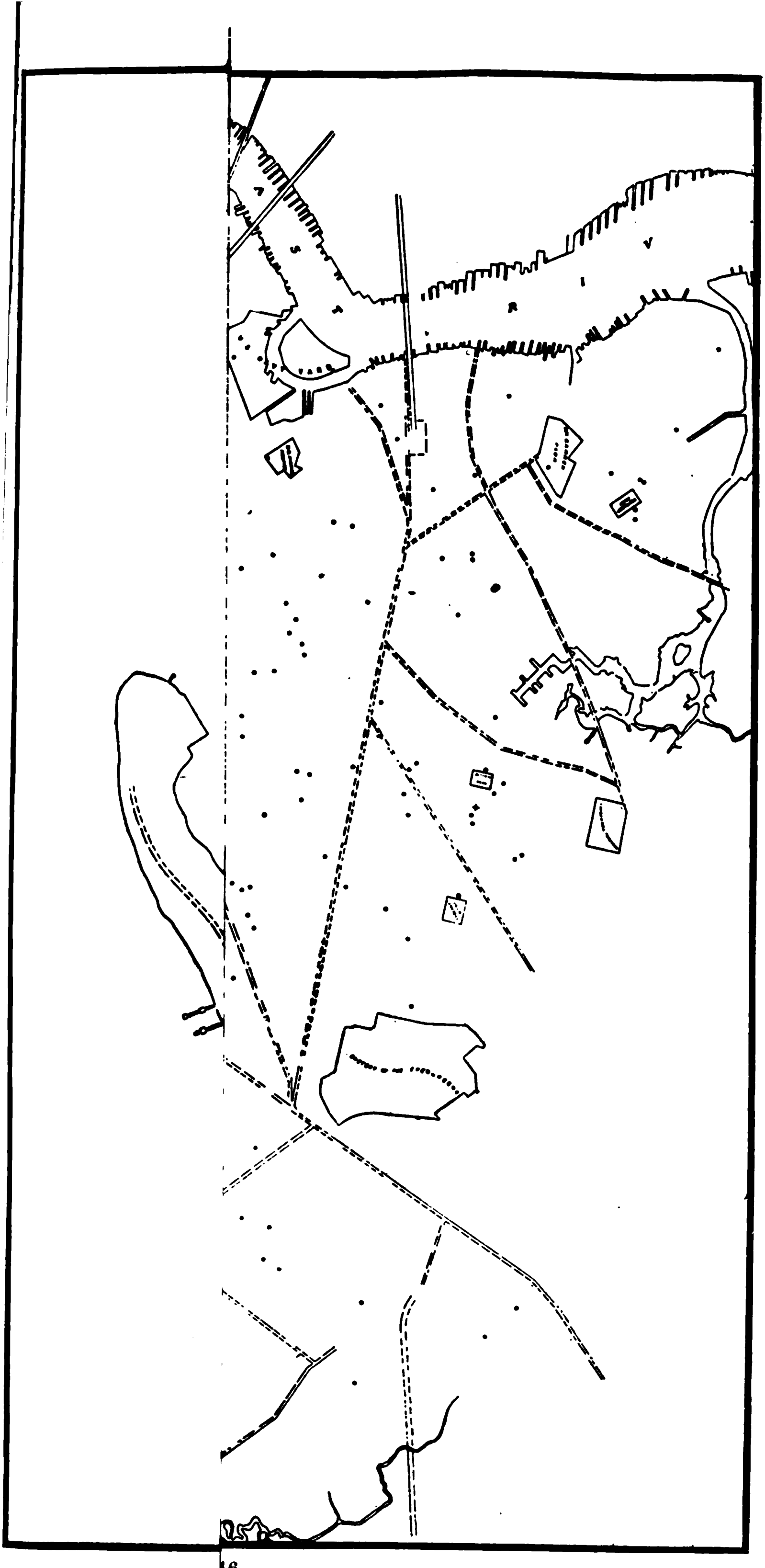
Map A.—Greater New York and

17146°—



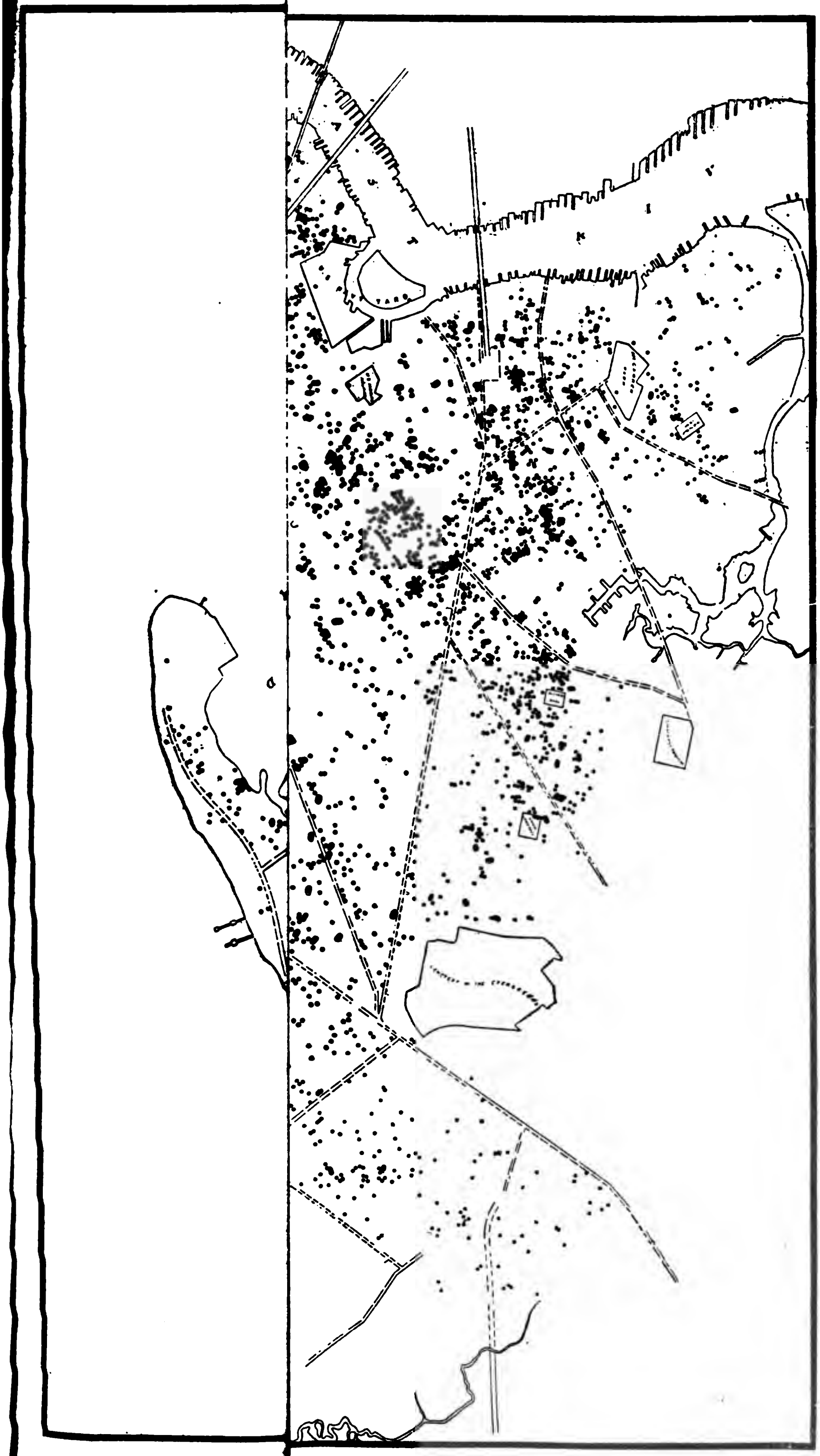
ust, 1916.

17146°—



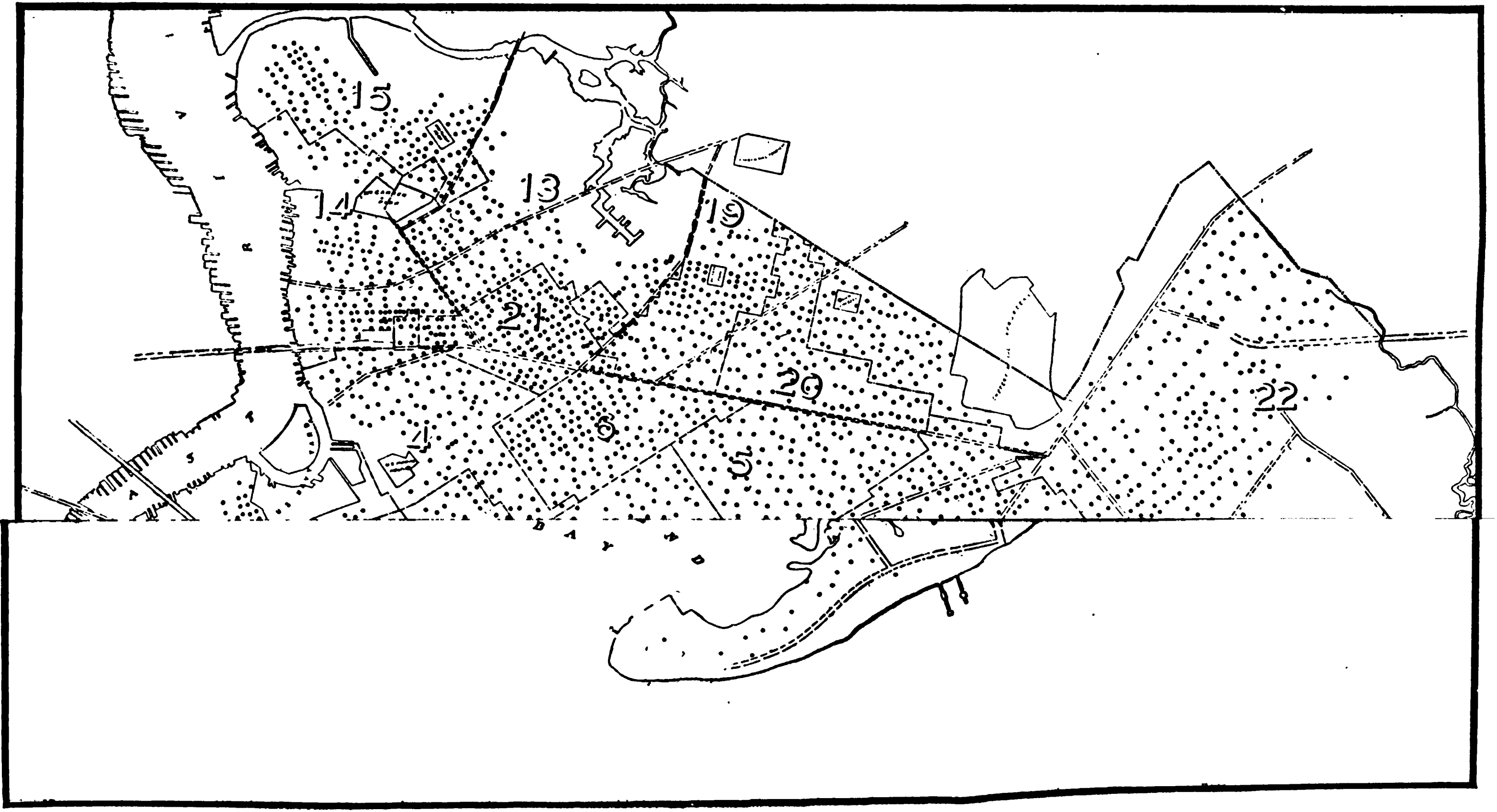
16.

17

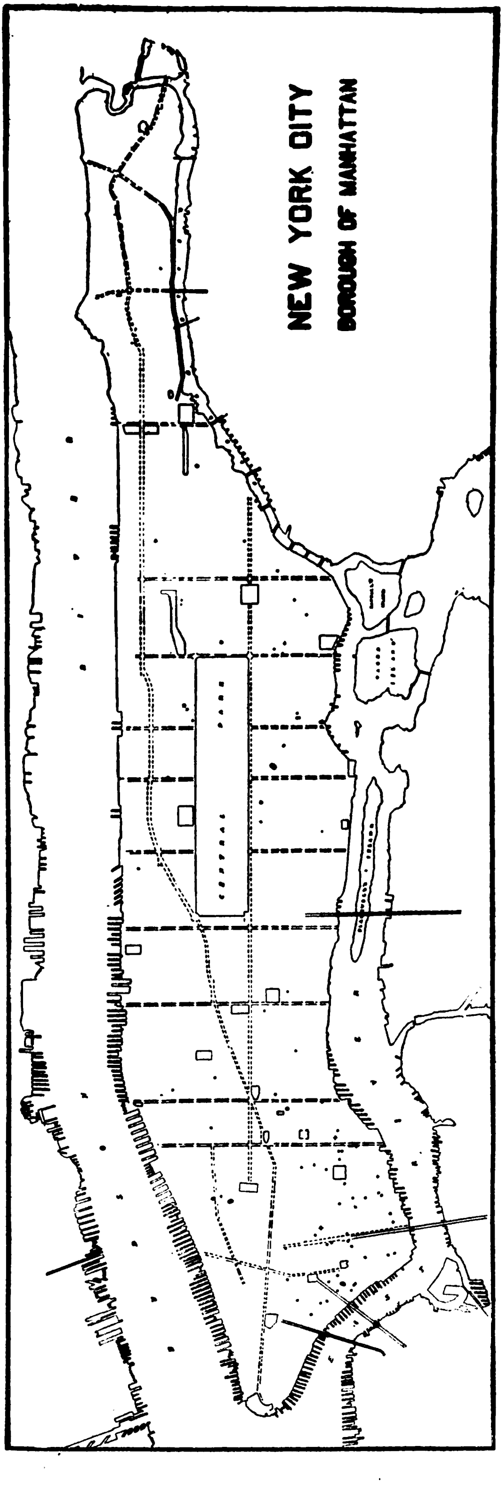


f 1916.

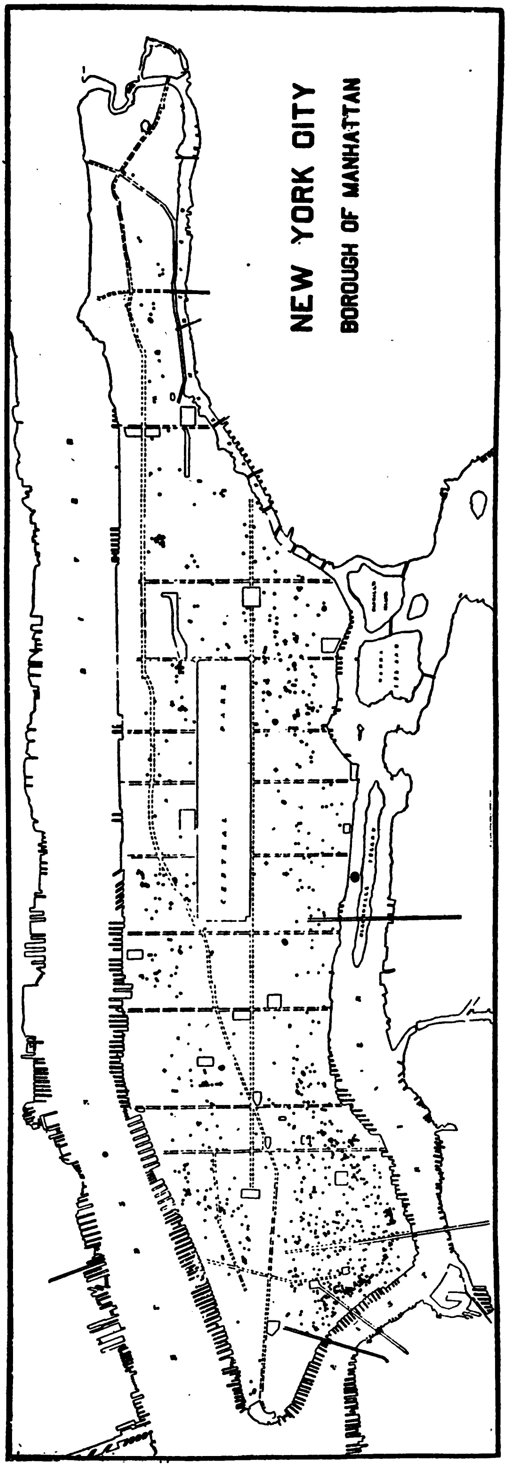
17146



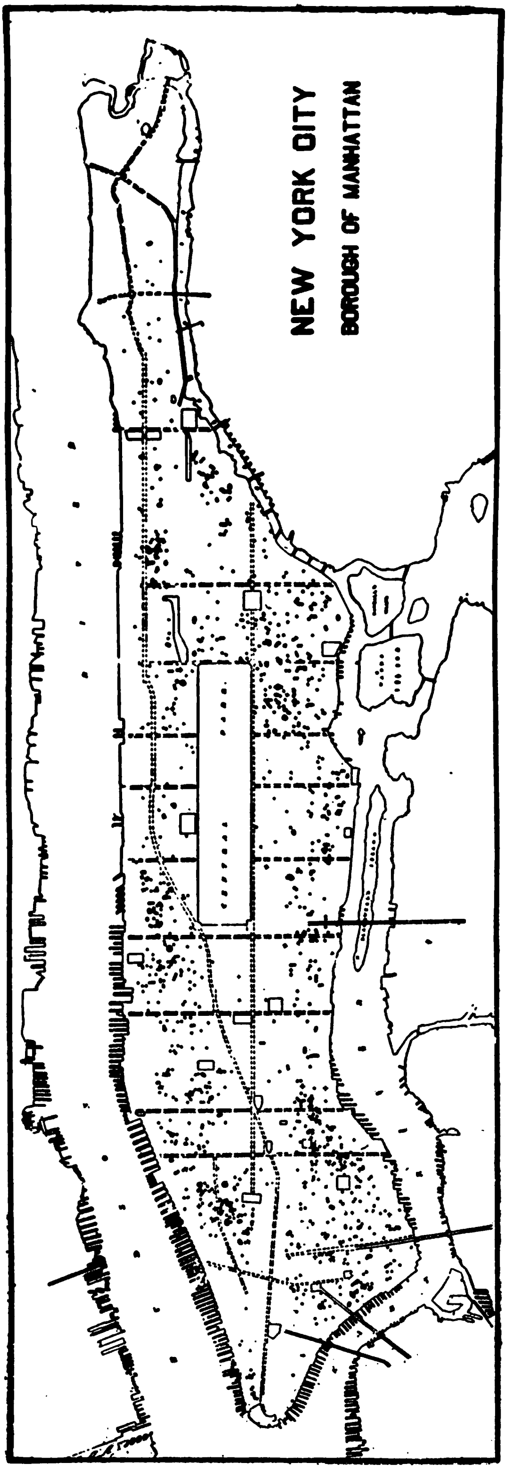
presents 500 people.



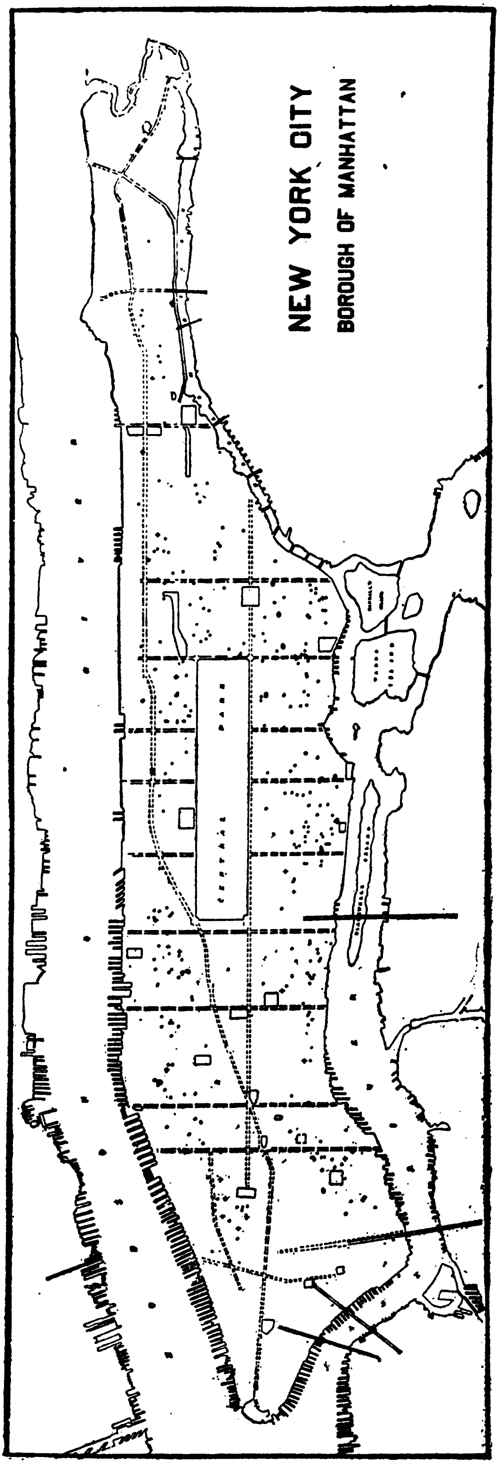
MAP I.—New York City, Borough of Manhattan. Distribution of cases of poliomyelitis. Onset in May (star) and June (dot), 1916.



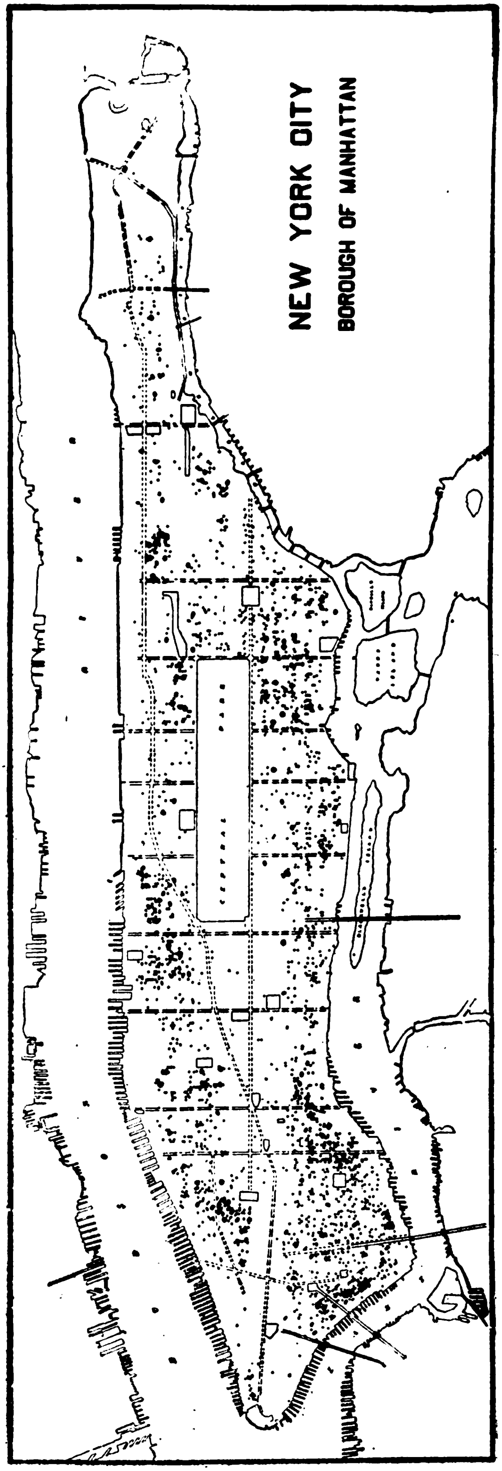
Map J.—New York City, Borough of Manhattan. Distribution of cases of poliomyelitis. Onset in July, 1916.



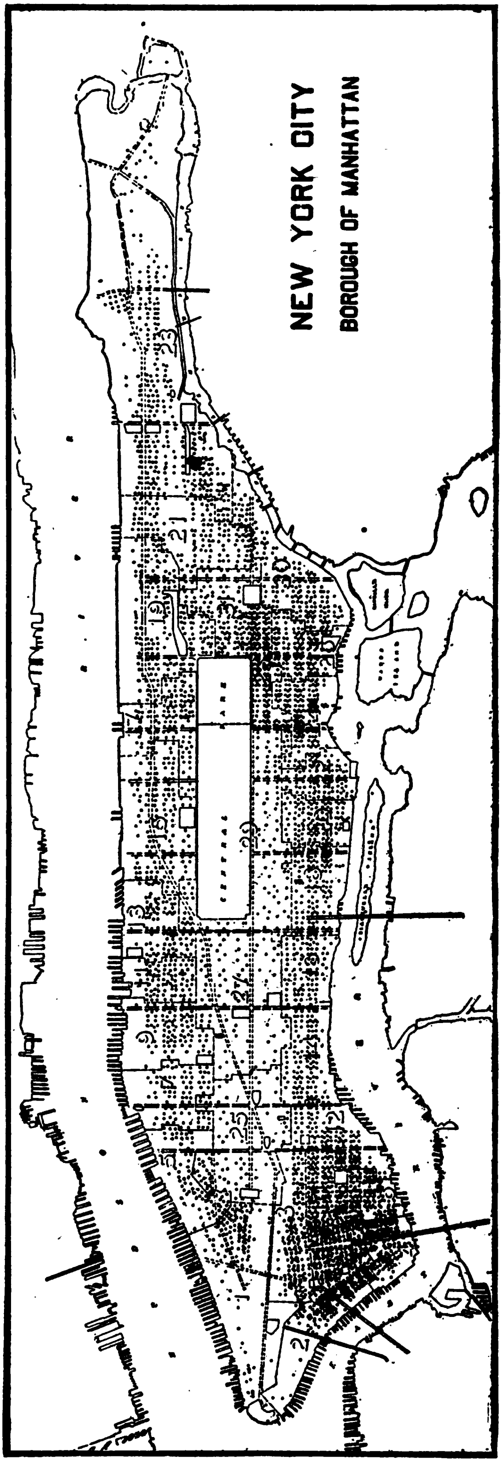
MAP K.—New York City, Borough of Manhattan. Distribution of cases of poliomyelitis. Onset in August, 1916.



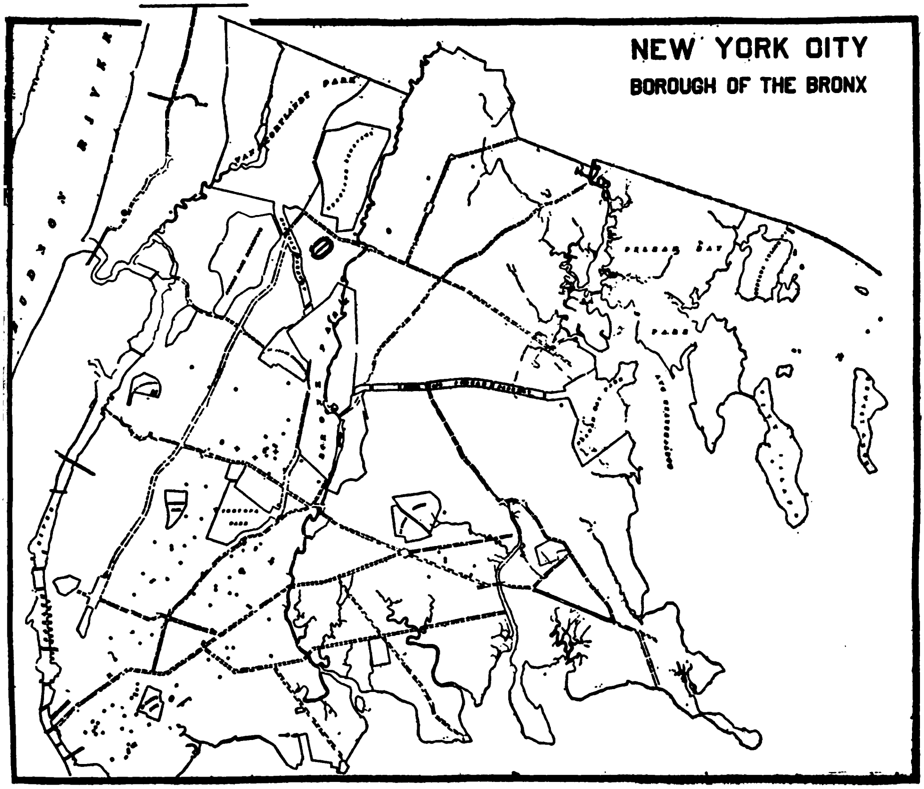
MAP L.—New York City, Borough of Manhattan. Distribution of cases of poliomyelitis. Onset in September, 1916.



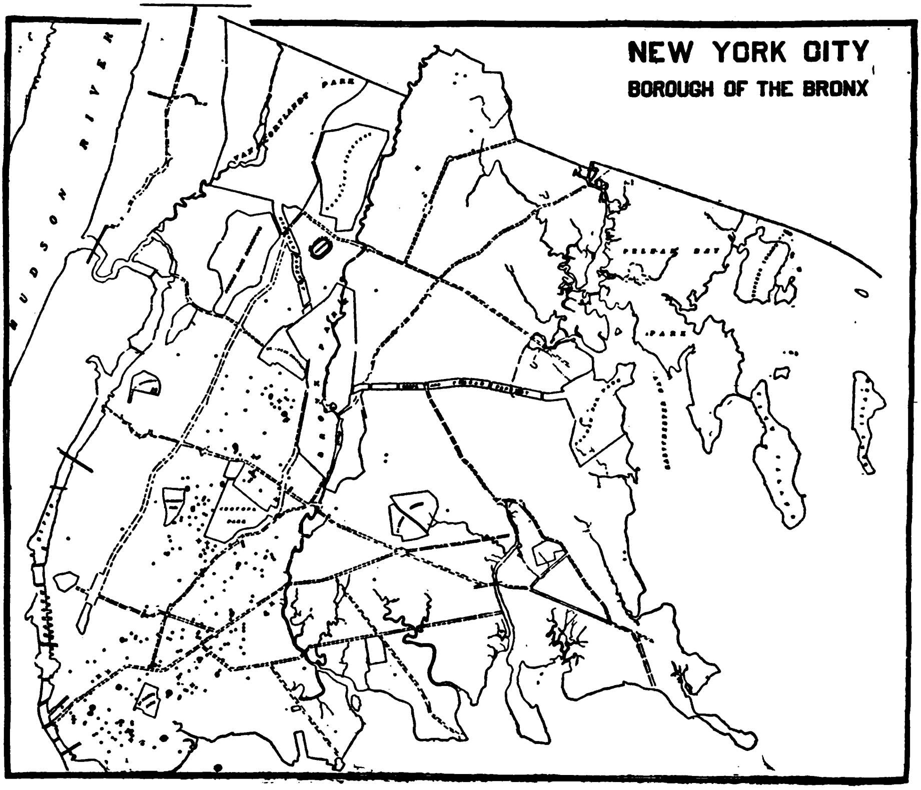
MAP M.—New York City, Borough of Manhattan. Distribution of cases of poliomyelitis. Total cases epidemic of 1916.



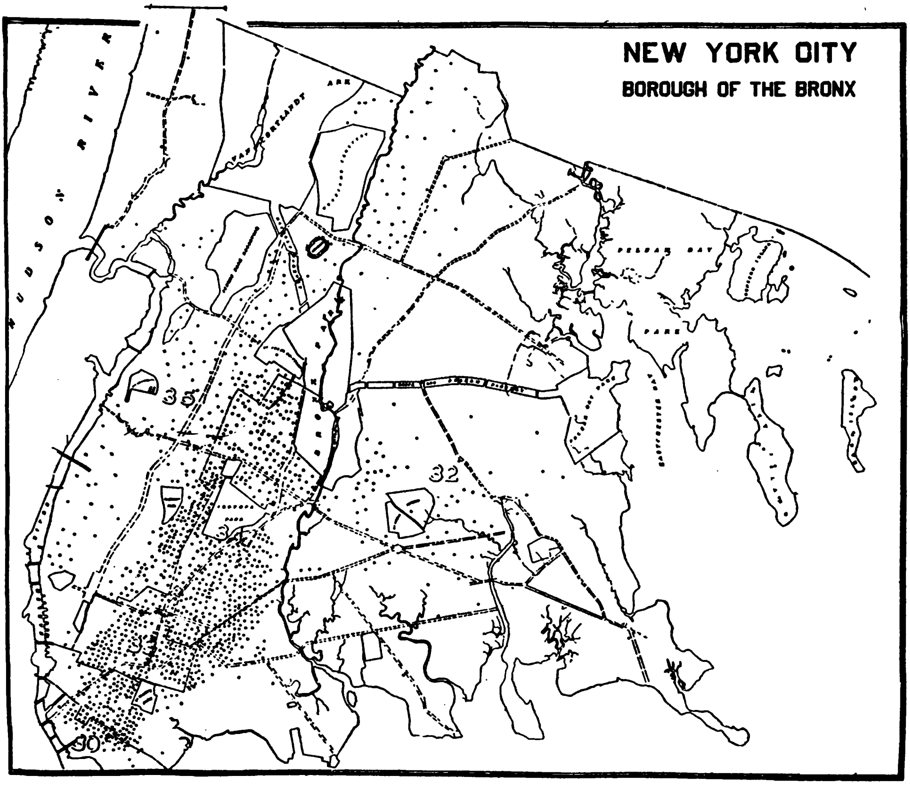
MAP N.—New York City, Borough of Manhattan. Distribution of population according to the U. S. Census 1910. Each dot represents 500 people.



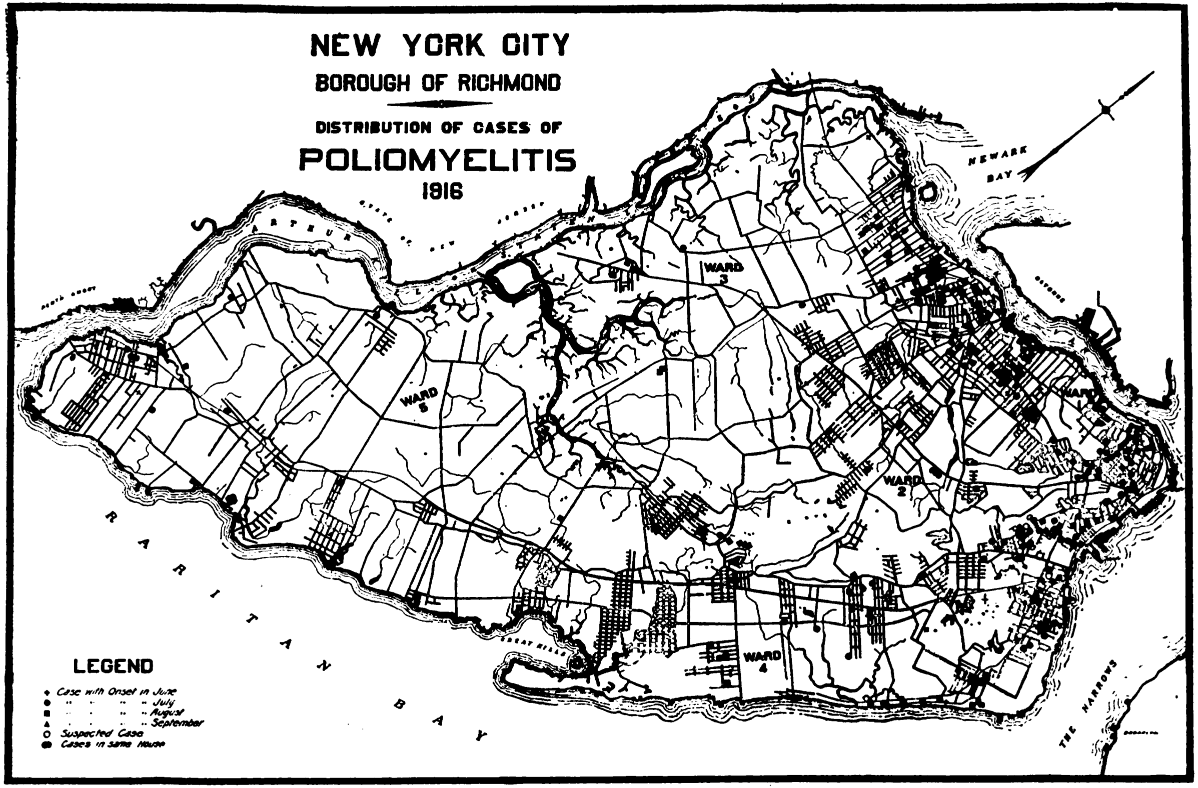
MAP O.—New York City, Borough of the Bronx. Distribution of cases of poliomyelitis. Onset in July, 1916.



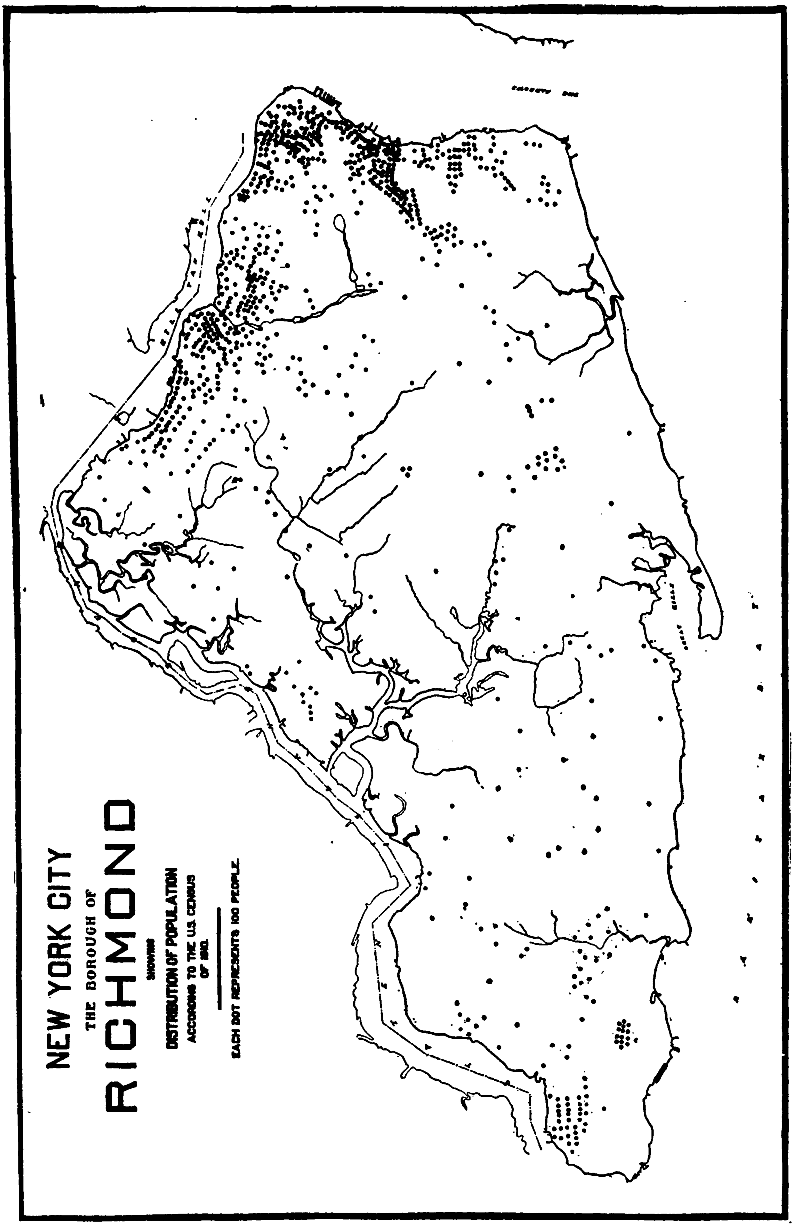
Map Q.—New York City, Borough of the Bronx. Distribution of cases of poliomyelitis. Onset in August.



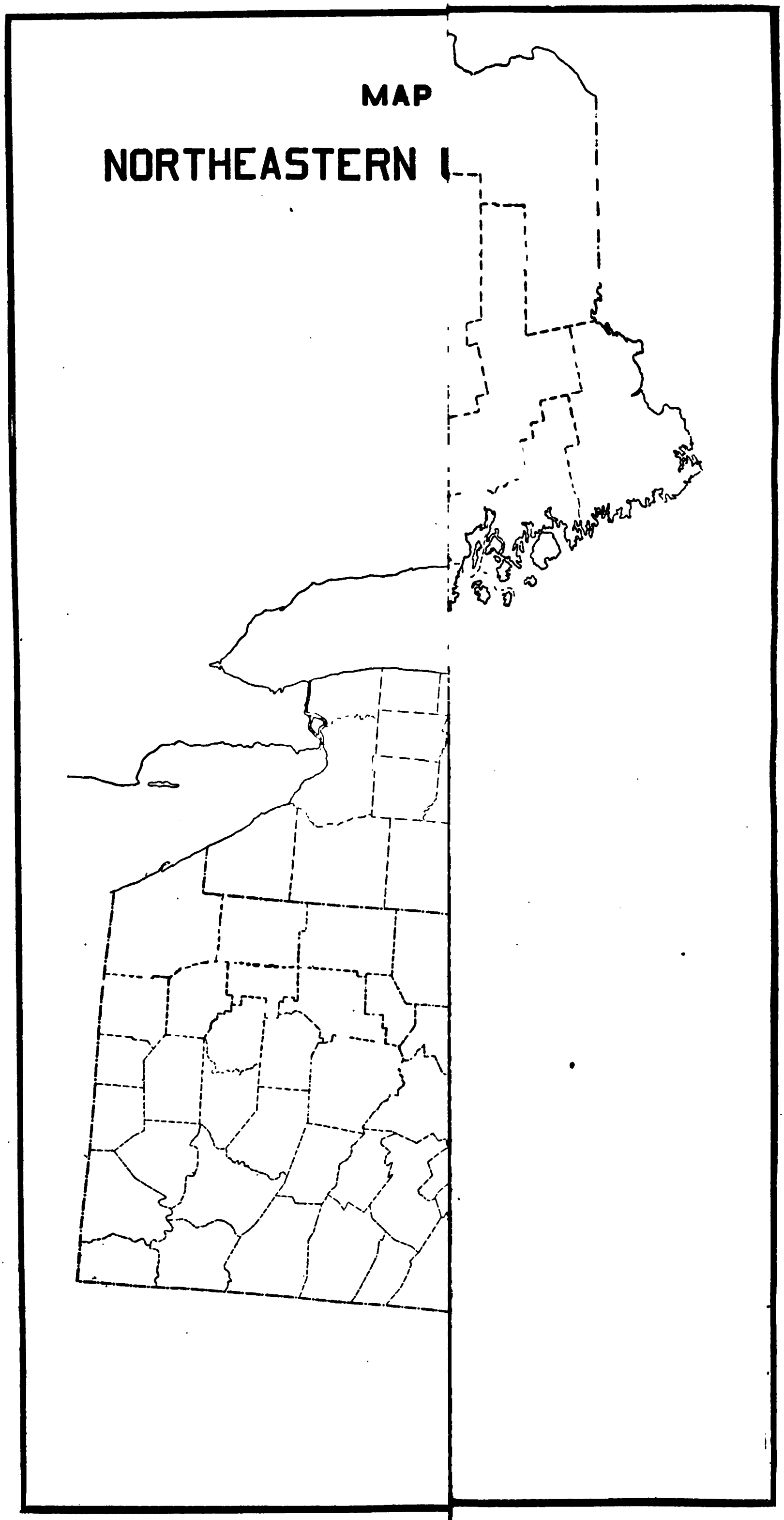
Map 8.—New York City, Borough of the Bronx. Distribution of population according to the U. S. Census 1910. Each dot represents 500 people.


NEW YORK CITY
BOROUGH OF RICHMOND
DISTRIBUTION OF CASES OF
POLIOMYELITIS
1916
NEWARK BAY
ARTHUR KILL
STATE OF NEW JERSEY
RARITAN BAY
THE NARROWS
GREAT KILLS
WARD 1
WARD 2
WARD 3
WARD 4
WARD 5
LEGEND
◆ Case with Onset in June
● " " " " July
■ " " " " August
▲ " " " " September
○ Suspected Case
⬬ Cases in same House

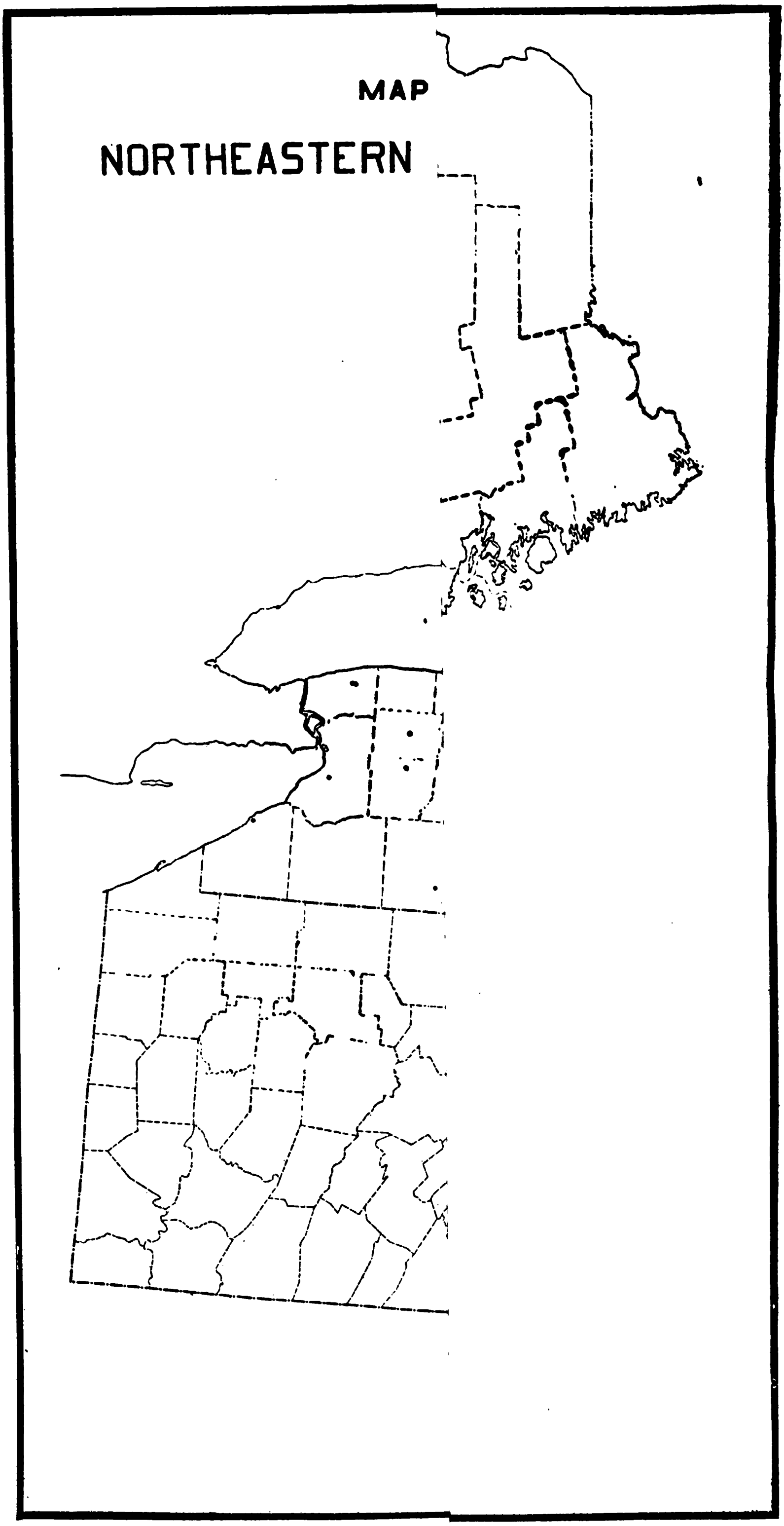
MAP T.


NEW YORK CITY
THE BOROUGH OF
RICHMOND
SHOWING
DISTRIBUTION OF POPULATION
ACCORDING TO THE U.S. CENSUS
OF 1910.
EACH DOT REPRESENTS 100 PEOPLE.

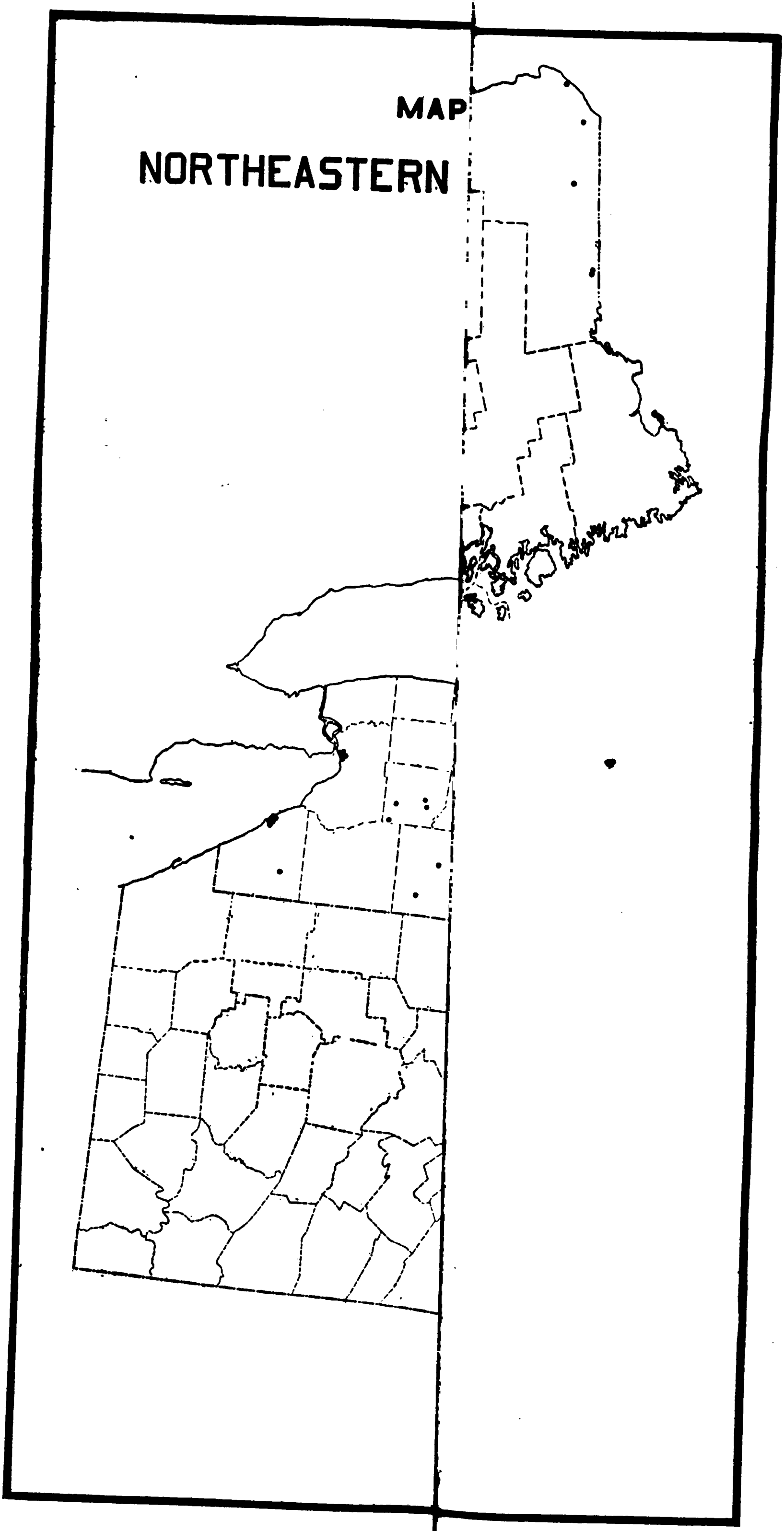
MAP U.



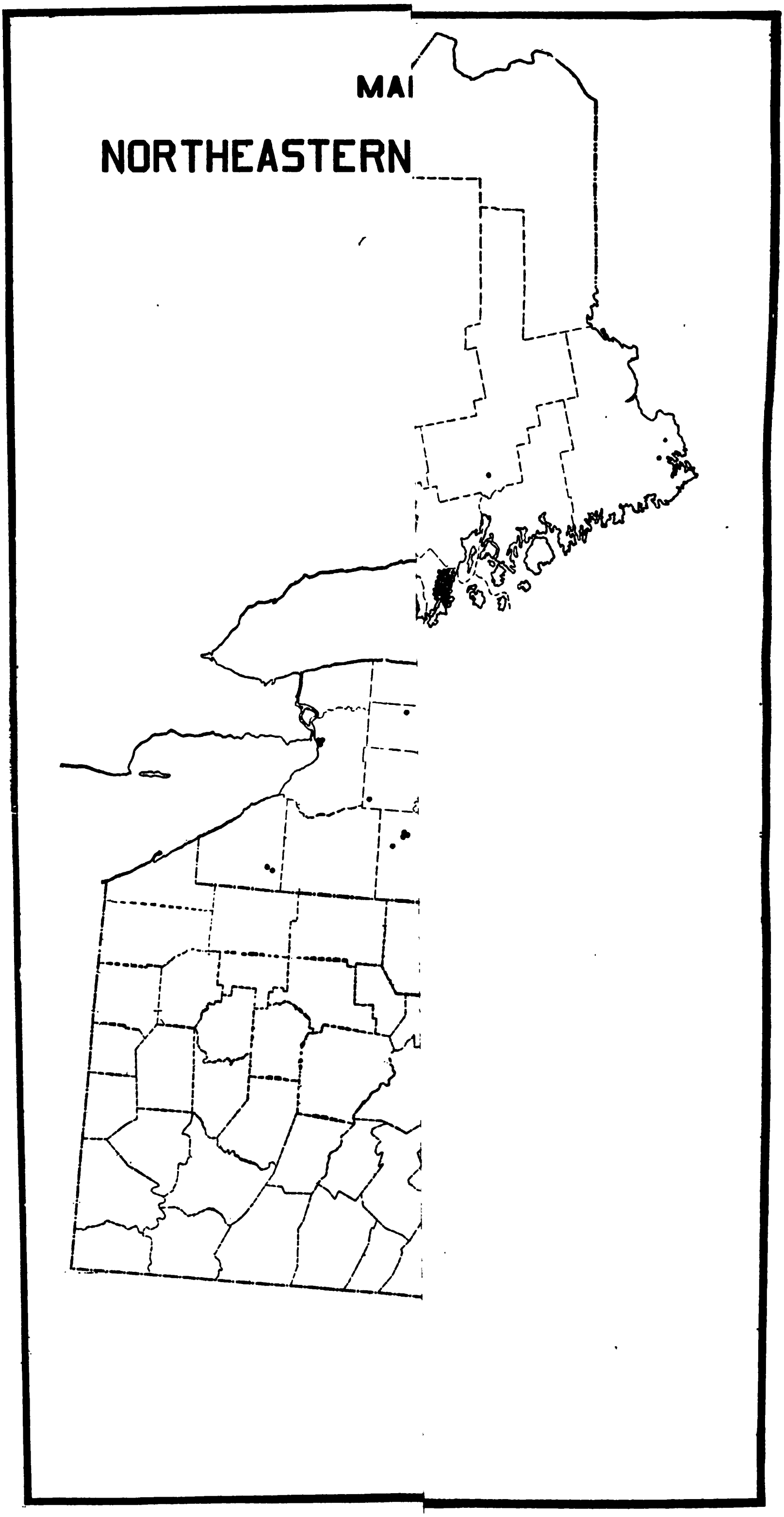
17146°—18. (To face p



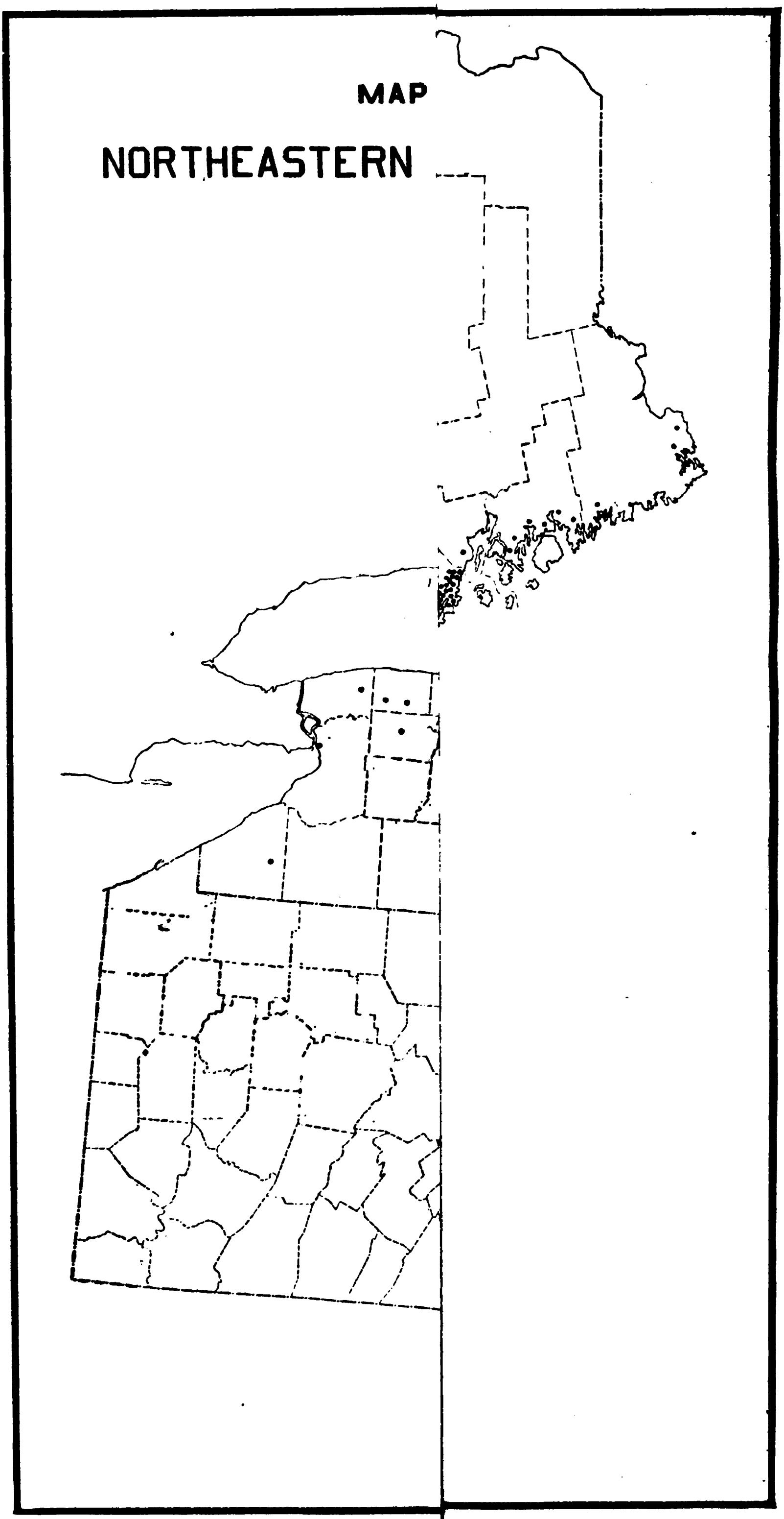
17146°—18. (To face p



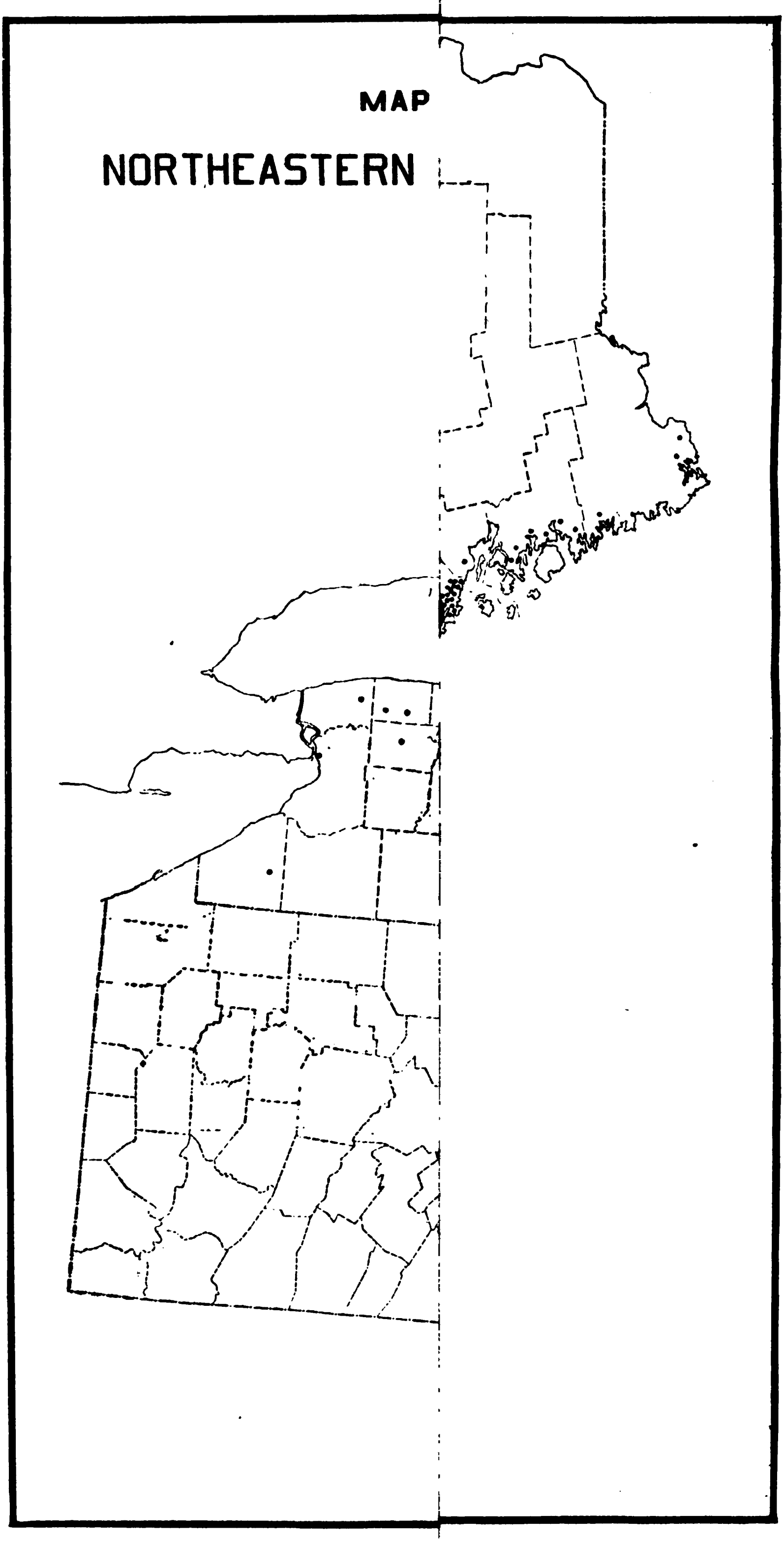
17146°—18. (To face p



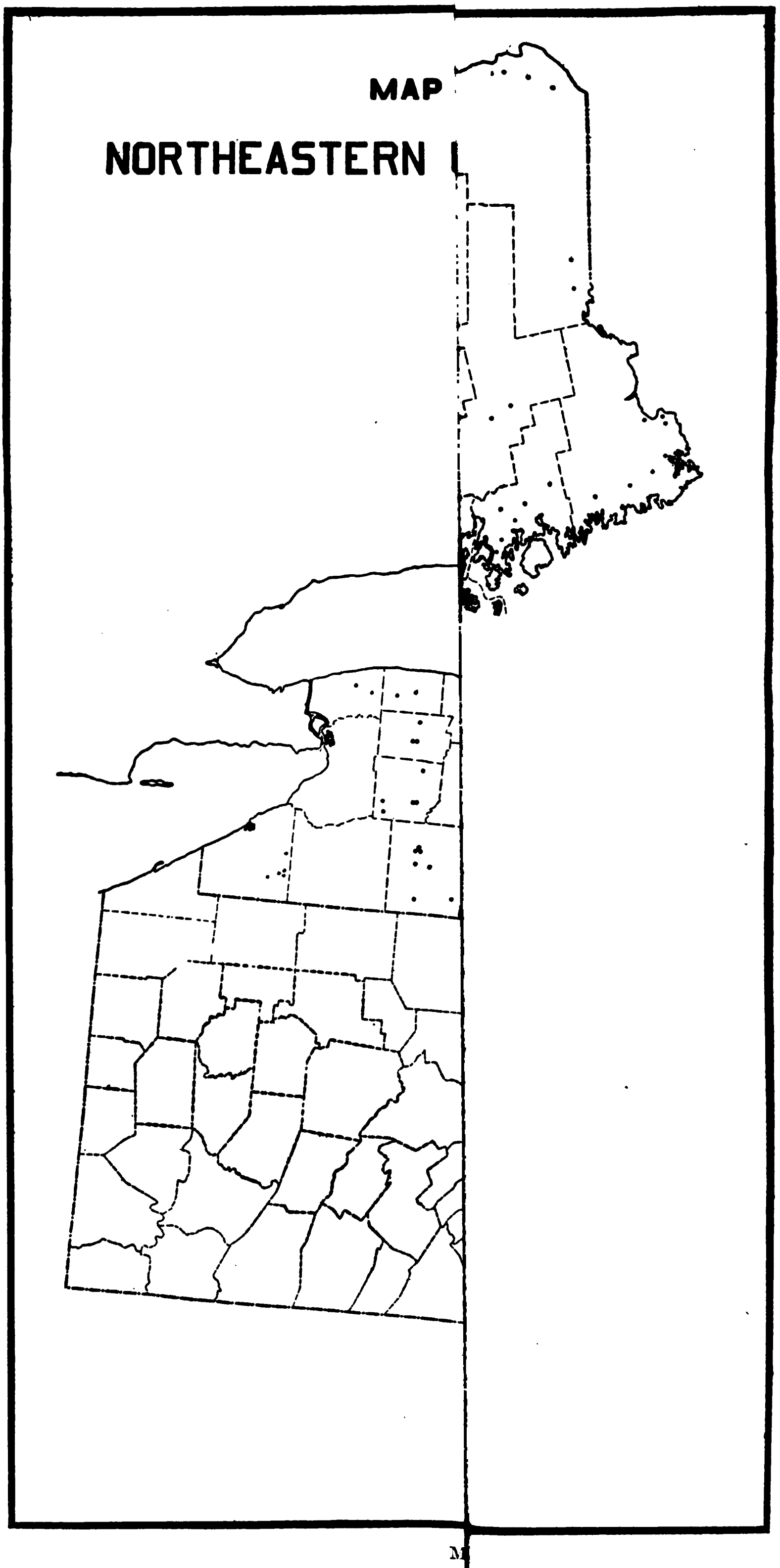
17146°—18. (To face



17146°—18. (To face

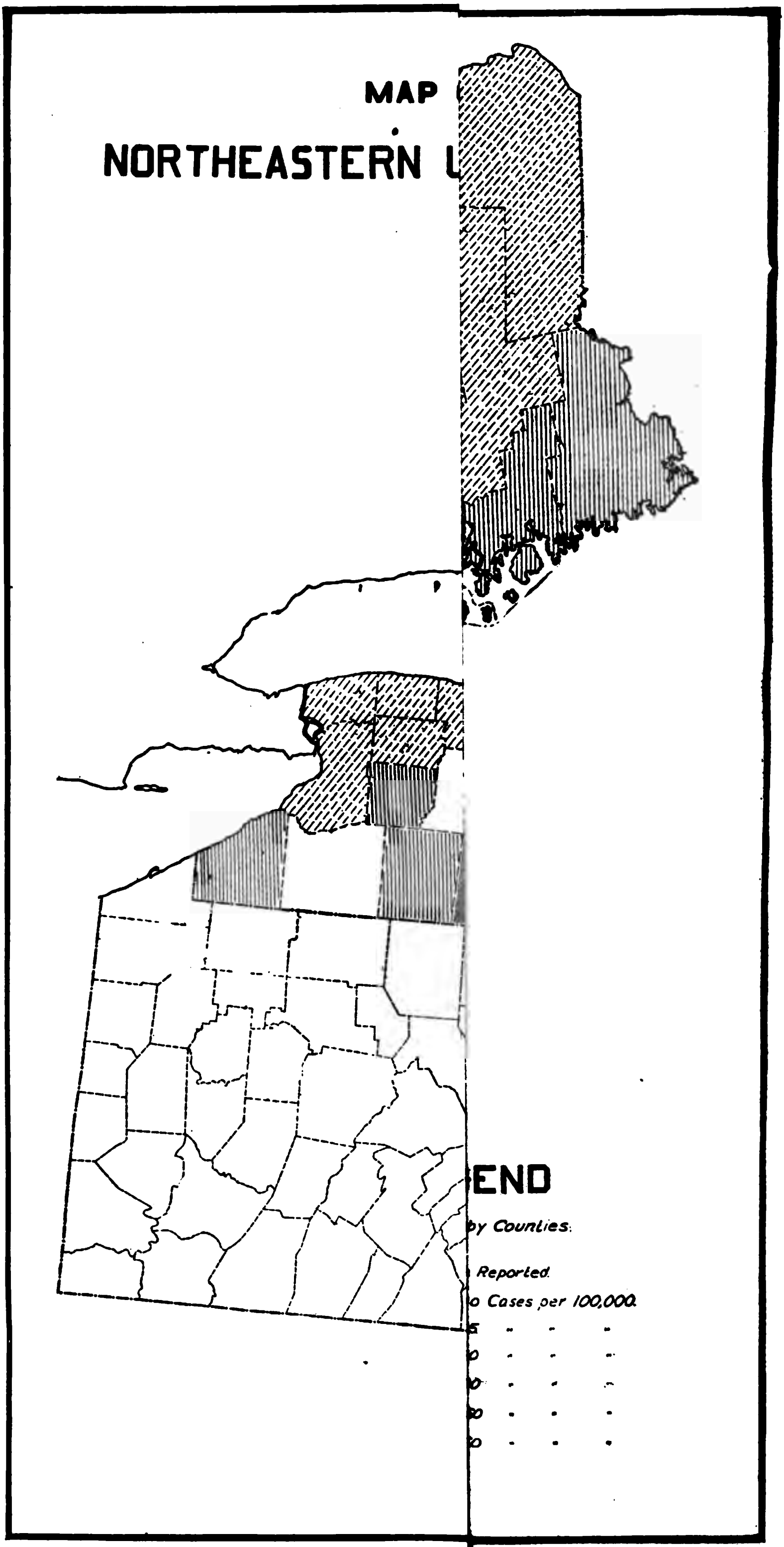


17146°—18. (To face



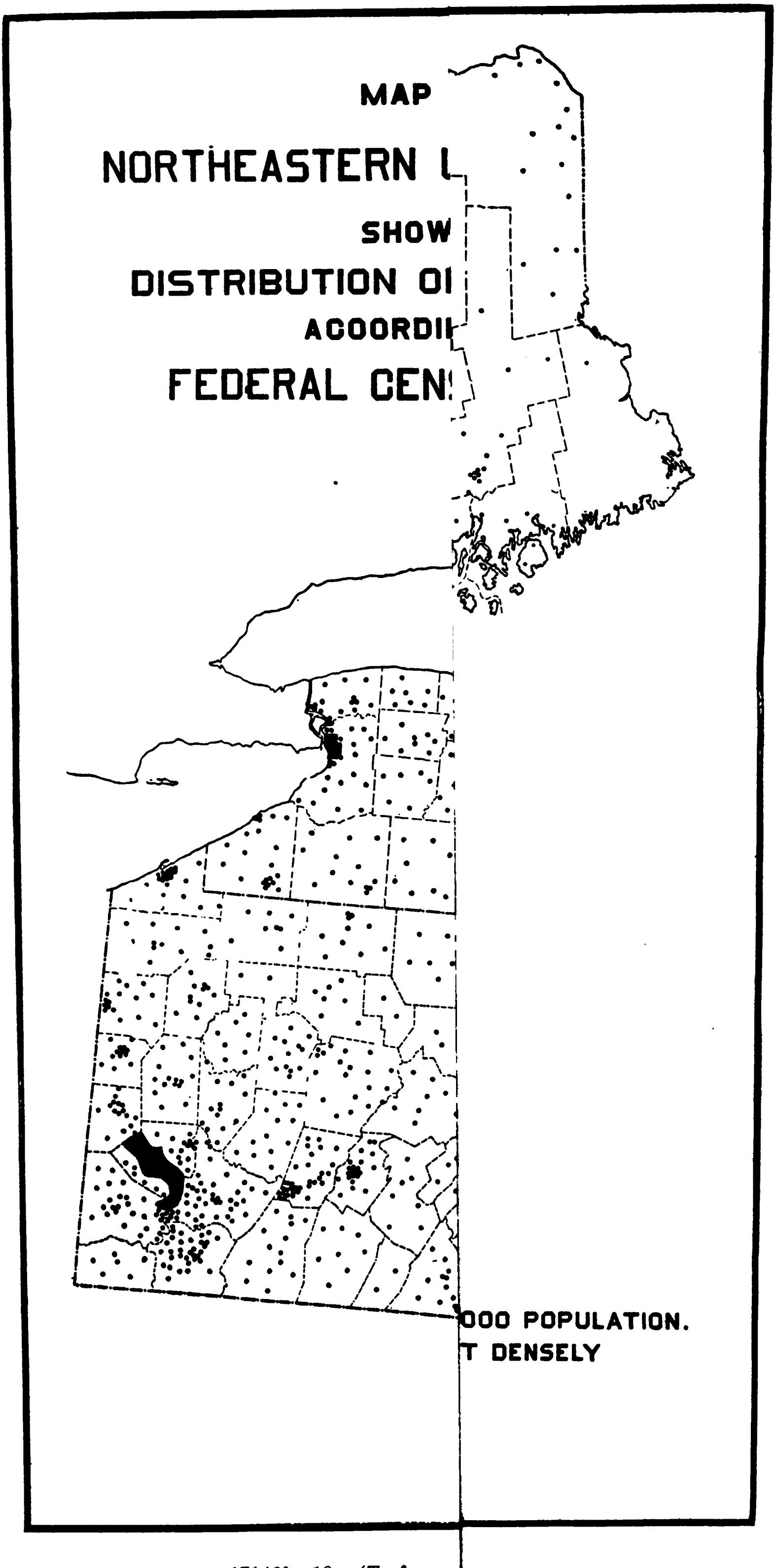
M

17146°—18. (To face pag

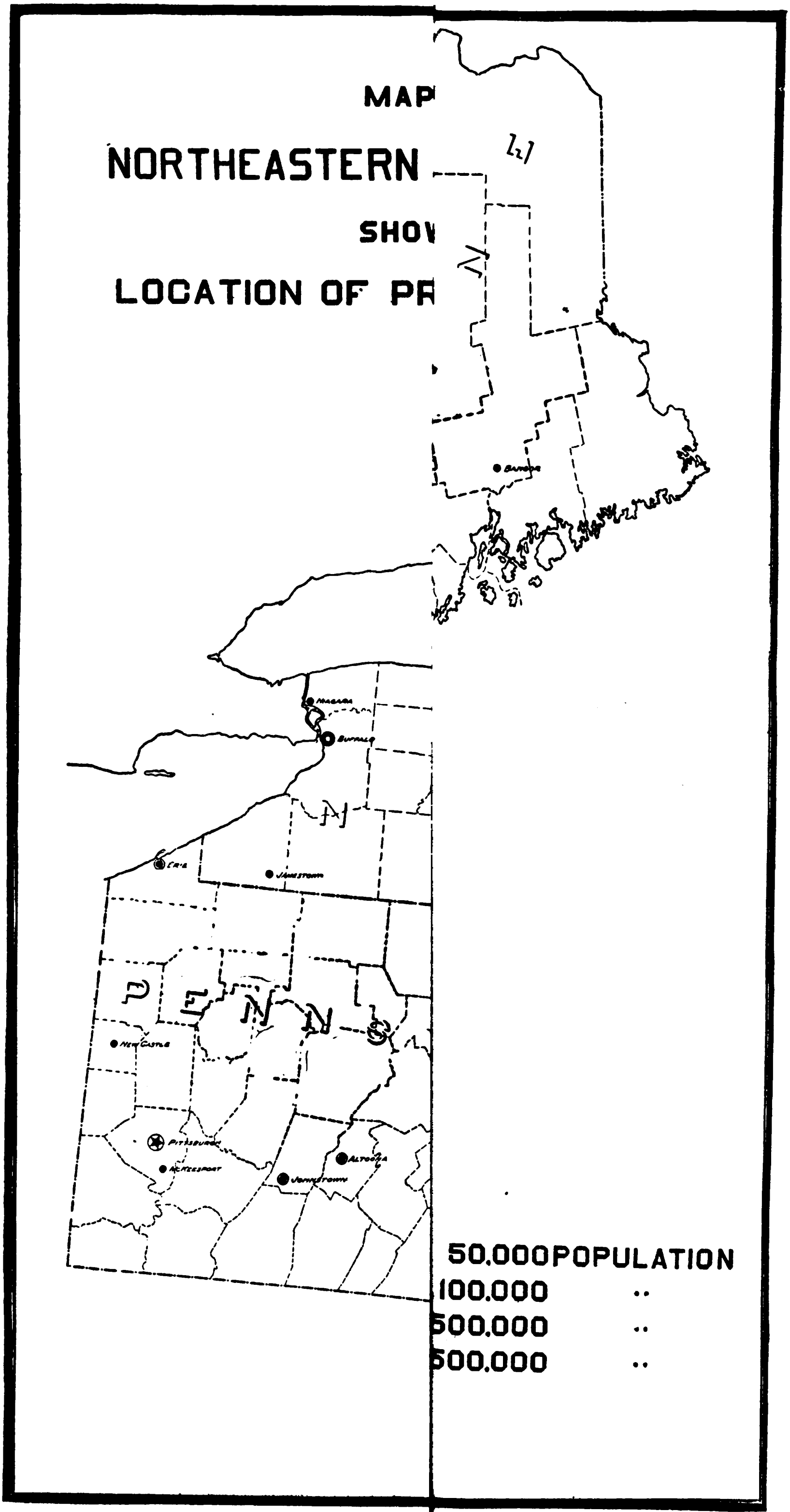


M

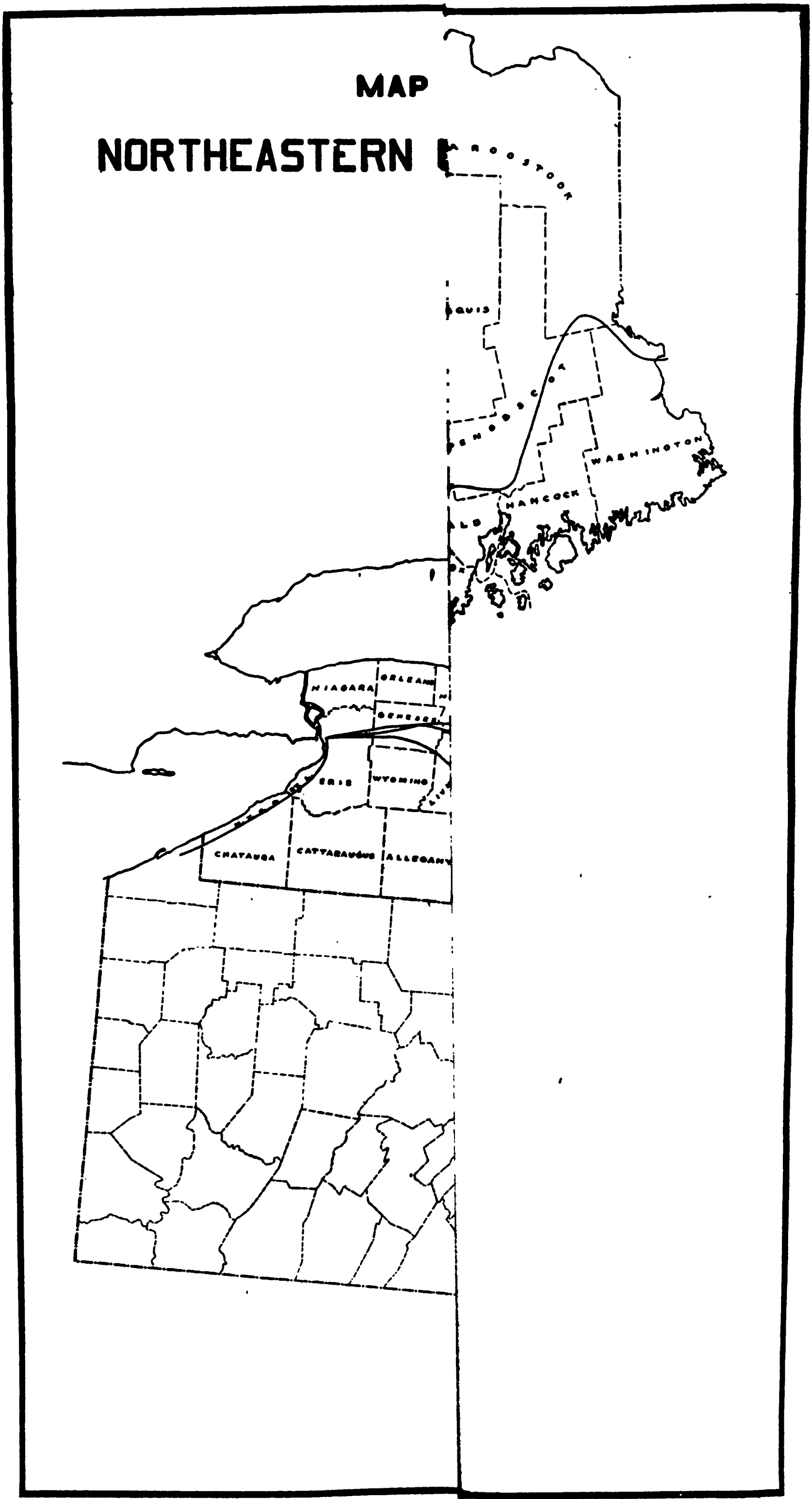
17146°—18. (To face page



17146°—18. (To face pa



17146°—18. (To face page 2



17146°—18. (To face pa

INDEX.

A.

Abortive cases. (*See* Suspicious cases.)
Age distribution:
  Diphtheria— Page.
    Fatality at different ages, Pennsylvania, 1907–1912 120
    Incidence in general population and in persons in family in which there is case, Providence, R. I. 127
    Interval between initial and subsequent cases in same family 129
  Measles, Fatality at different ages, Kansas, 1914–1915 120
  Poliomyelitis—
    Attack rates—
      At different ages, New York epidemic 110
    Initial and subsequent attack rates in families having cases—
        Previous epidemic 125
        New York epidemic 125
    Deaths, 1910–1915, by States 80
    Discussion, New York epidemic 107
    Fatality, New York epidemic—
      At different ages 120
      By sex and age 119
      Variations, by boroughs 122
    Final summary 211
    Incidence in general population as compared to incidence in persons in families having cases, New York epidemic 126
    Interval between initial and subsequent cases in same family, New York epidemic 129
    New York City cases and those outside compared 186
    Rural and urban districts compared—
      Northeastern United States epidemic 186
      Previous epidemics, United States 109
    Secondary cases in families—
      Intensive studies, Northeastern United States 201
    Sex distribution at different ages, New York epidemic 115
    Studies in four States, 1916 185
    Tables 228
      New York epidemic 229, 230, 231, 233, 236, 238
      Northeastern United States 269, 270, 271, 273, 274
    Variations in age distribution during course of New York epidemic 112
  Scarlet fever—
    Fatality at different ages, Pennsylvania, 1907–1912 120
    Incidence in general population and in persons in family having case, Providence, R. I 127
    Interval between initial and subsequent cases in same family 129
  (*See also* Children.)

Animals: Page.
  In relation to epidemic of poliomyelitis 214
  Paralytic disorders in, study of 206
Area included in 1916 epidemic of polio 162
Assembly districts (New York City), poliomyelitis in, 1916—
  Coefficient of dispersion, Brooklyn 100, 102
  Distribution by 98
  Incidence, children under 10, Brooklyn and Manhattan 103
August cases, poliomyelitis, New York city epidemic 91
Austria, case fatality poliomyelitis, 1908–9 119
Autopsy material, collection of—
  Animal 207
  Human 208

B.

Bears, study of paralytic disorders in 207
Bibliography, world prevalence of poliomyelitis 37
Boroughs (New York):
  Poliomyelitis incidence, 1911-1915 97, 215
  Poliomyelitis, 1916—
    Age distribution 108
      Tables 228, 229, 230, 236
    Days, cases and deaths by 219
    Fatality, variations in 122, 235
    Final summary 209
    Incidence by boroughs 93, 95, 96, 98, 217, 219, 223, 224
    Multiple cases in families 124
    Onset—
      Cases by day of 217
      Cases and case-rate by date of, by weeks 223
    Sex distribution of fatal cases 236
    Spread of New York epidemic 104
  (*See also* Assembly districts; Manhattan, Bronx, etc.)
Bronx:
  Description 83
  Poliomyelitis, 1916—
    Age distribution 108
    August cases 91
    Fatality 122
    First case 90
  Interval between initial and subsequent cases in same family 129
    July cases 91
    Multiple cases in families 124
    October cases 92
    September cases 92
    Spread of New York epidemic to the Bronx 106
  (*See also* Boroughs.)
Brooklyn:
  Description 83
  Poliomyelitis, 1916—
    Age distribution—
      Discussion 108
      Variations in, during course of epidemic 112
    August cases 91

Brooklyn—Continued.
  Poliomyelitis, 1916—Continued. Page.
    Center of concentric zones showing wavelike spread of United States epidemic 168
    Coefficient of dispersion, 1916, for assembly districts 100, 102
    Fatality 122
    Incidence, children under 10, by assembly districts 104
    Interval between initial and subsequent cases in same family 129
    July cases 90
    June cases 89
    Multiple cases in families 124
    October cases 92
    Origin of epidemic 87
    September cases 92
    Spread of epidemic 105, 226
    Weeks, cases by, by assembly districts 224
    Zones, with center in Brooklyn, incidence by weeks—
      In Brooklyn alone 226
      In Greater New York 227
      In northeastern United States 262
  (*See also* Boroughs; New York.)
Buffalo, poliomyelitis epidemic, 1912:
  Cases 109
  Sex distribution 114
Bull, account of epidemic 25

C.

Calves, study of paralytic disorders in 207
Cards, form used for poliomyelitis reports:
  New York studies 84
  Richmond intensive studies 139
Case card. (*See* card.)
Case fatality. (*See* fatality.)
Cats, study of paralytic disorders in 207
Cause of poliomyelitis, specific organism 13
Cerebrospinal meningitis, epidemic. (*See* Meningitis.)
Chicago:
  Diphtheria—
    Coefficient of dispersion by wards, 1910 100
    Incidence, 1910, by wards 101
  Scarlet fever—
    Coefficient of dispersion by wards, 1910 100
    Incidence, 1910, by wards 101
Chickenpox, sex distribution, Philadelphia, 1910–1912 117
Chickens, study of paralytic disorders 207
Children, poliomyelitis in:
  Age distribution—
    Rural and urban epidemics, United States 109
    Variations in, during course of New York epidemic 112
  Attack rate at different ages, New York epidemic 110
  Fatality by sex and age 119
  Incidence, New York epidemic 102
  (*See also* Age distribution; Sex distribution.)

Chronology. (*See* Travel routes; Zones; Days; Weeks; Mathematical Relations.)

Cincinnati, poliomyelitis in: Page.
- Cases, epidemic, 1911 109
- Fatality, 1911 119
- Sex distribution, 1910 114

Cities, poliomyelitis in:
- Age distribution—
  - For various epidemics in cities of varying size 274
  - In certain States, by cities, according to size 273
  - In metropolitan districts, in groups of cities of various sizes, and in rural districts, northeastern United States, 1916 271
- Cases, by weeks—
  - Northeastern United States, 1916 166
    - Northeastern United States, 1916, according to population 261
- Cities over 10,000, cases by, by weeks, with rates 252
- Final summary 212
- Percentage of first cases in infected cities apparently exported from New York City 182
- Variations in attack rates according to size of cities, United States epidemic, 1916 167
- Variations in prevalence in cities according to distance from New York City, 1916 167
- (*See also* Urban.)

Climatological conditions, New York poliomyelitis epidemic 130, 239, 240

Clinical picture of poliomyelitis 12

Coefficient of dispersion:
- Discussion 100
- Final summary 211
- Poliomyelitis by assembly districts, Brooklyn, 1916 ...... 100, 102

Combined poliomyelitis studies in New York City and northeastern United States:
- Contact as shown by 202
- Development of secondary cases 203

Communicable diseases, sex distribution 117

Concentric zones. (*See* Zones.)

Conclusions, general 209

Conditions. (*See* Environmental.)

Connecticut, poliomyelitis epidemic, 1916:
- Age distribution 185, 269
- Contact with previous cases 200
- Intensive studies of scattered cases 190
- Percentage of first cases apparently exported from New York City 182
- Weeks, cases by 163, 245
  - In cities over 10,000 254
- (*See also* Hartford.)

Contact with poliomyelitis cases
- As shown by studies in New York City and in northeastern United States 202
- Contact relation of first cases to previous foci, intensive studies northeastern United States 196
- Contact relationship between cases, intensive studies, northeastern United States ...... 199.

Contact with poliomyelitis cases—Continued.
  Contact with previous cases— Page.
    Richmond epidemic 156
  Final summary 214
  (*See* also Secondary cases.)
Counties, poliomyelitis in, 1916:
  Spread in small units of population 170
  Summary of county studies 179
  Weeks, cases by—
    Discussion 165
    Tables 243, 244, 245, 246, 247, 249, 250
Course, Richmond poliomyelitis, epidemic 142
Crest of poliomyelitis epidemic, New York City 107, 137
Cumulative incidence New York poliomyelitis epidemic 223
Cycle of poliomyelitis prevalence 67

D.

Day of onset. (*See* Onset.)
Decline of poliomyelitis epidemic, forecasting 134
  Final summary 211
Delaware, poliomyelitis, in 1916:
  Cases, by weeks 163, 250
    In cities of over 10,000 260
Diagnosis of poliomyelitis, mistakes in, cause of error:
  In morbidity reports 44
  In mortality reports 46
Diffusion of poliomyelitis. (*See* Zones.)
Diphtheria:
  Attack rates, initial and subsequent, in families, Providence, R. I., 1904–1913 125
  Coefficient of dispersion in different wards, Chicago, 1910 100
  Fatality, Pennsylvania, 1907–1912 120
  Incidence, Chicago, by wards, 1910 101
  Incidence in general population and in persons in family with case, Providence, R. I. 127
  Interval between initial and subsequent cases in same family, Providence, 1904–1913 129
  Sex distribution, Pennsylvania, 1907–1912 234
Direct contact. (*See* Contact.)
Direction of movement of epidemic wave. (*See* Spread; Zones.)
Dispersion, coefficient of. (*See* Coefficient.)
District of Columbia, poliomyelitis in:
  Sex distribution, 1910 114
  Weeks, cases by, 1916 163, 251
Divisions. (*See* Travel routes.)
Dogs, Study of paralytic disorders in 207
Domestic animals. (*See* Animals.)
Dryness. (*See* Humidity.)
Ducks, Study of paralytic disorders in 207
Dust, Humidity in New York epidemic 132

E.

Endemic prevalence of poliomyelitis: Page.
  Annual rates, by States 70
  New York, 1913–1915 98
  Relation to New York epidemic 104
Entomological surveys 208
Environmental conditions, relation to poliomyelitis:
  Intensive studies in New Jersey, Connecticut, and Rhode Island 190
  Study of Richmond epidemic 149
Epidemic cerebrospinal meningitis. (*See* Meningitis.)
Epidemics of poliomyelitis, table of those recorded 27
Epidemiologic cards. (*See* Cards.)
Epidemiology of poliomyelitis, characteristics 16
Etiology of poliomyelitis. (*See* Cause.)
Exportation of poliomyelitis infection. (*See* New York City and northeastern United States.)

F.

Family:
  Diphtheria—Providence, R. I., incidence in general population and in persons in family with case 127
  Poliomyelitis, 1916—
    Grouping of primary and secondary cases, Richmond epidemic 154
    Incidence in general population as compared to incidence in persons in families having case, New York epidemic 126
    Multiple cases in families—
      Intensive studies, northeastern United States 201
      Richmond epidemic 152
    Occupations of wage earners in families having cases of poliomyelitis, Richmond 152
    Secondary cases—
      Richmond epidemic 153
      Wickmann 130
  Scarlet fever, Providence, R. I., incidence in general population and in persons in family with case 127
Fatality:
  Diphtheria, Pennsylvania, 1907–1912 120
  Measles, Kansas, 1914–15 120
  Poliomyelitis—
    Boroughs, New York epidemic 122
    Comparative fatality, males and females, New York epidemic 122, 238
    Final summary 211
    General, New York epidemic 118, 238
    Previous epidemics 119
      United States, 1916 77
    Rates—
      Ratio not constant 46
    Sex and age—
      New York epidemic—
        Discussion 119
        Table 238
    Variation, by boroughs, New York epidemic 122
    Weeks, New York epidemic 118
  Scarlet fever, Pennsylvania, 1907–1912 120

Female. (*See* Sex distribution.) Page.
Final summary 209
First cases, poliomyelitis, 1916:
  Contact relation of first cases to previous foci, intensive studies of northeastern United States 196
  Percentage of first cases in infected cities apparently exported from New York City 182
  Richmond epidemic 143
  Time of development of, New York poliomyelitis epidemic 129
Food supply:
  Richmond poliomyelitis epidemic, relations to 150
  (*See also* Milk.)
Forecasting decline of New York poliomyelitis epidemic 134

G.

General contact. (*See* Contact.)
Geographic distribution of poliomyelitis, 1916:
  Cases (map) 79
  Final summary 209
  Knowledge about 16
  Progressive spread of high mortality rates, United States 69
  Richmond poliomyelitis epidemic 146
  (*See also* Spread.)
Geographic divisions, principal, United States, poliomyelitis in:
  Incidence, 1909–1915 48, 60
  Death rates, by years, 1909–1915 67
  Percentage which registration population is of total population in each 47
  Summary cases, 1909–1916 66
Geometric progression of number of poliomyelitis cases. (*See* Mathematical relations.)
Goats, study of paralytic disorders in 207
Grouping of primary and secondary cases in families in Richmond poliomyelitis epidemic 154

H.

Hartford county:
  Description 171, 189
  Poliomyelitis, 1916—
    Chronological relation to rest of epidemic 171
  Chronology of cases in minor civil divisions of county 172, 264
    Contact history of first cases in towns 197
    Contact with previous cases 199
    Environmental conditions, relation of cases to 190
    Intensive study in 187
    July cases 172
    Record of epidemic, 1916 171, 264
    Spread of poliomyelitis, 1916 170
Health department, New York. (*See* New York.)
Health Service, public. (*See* Public Health Service.)
Highland Park, N. J.:
  Description 188
  Study of poliomyelitis in 187

Page.
History of cases, Richmond poliomyelitis epidemic — 143
Hudson, N. Y., beginning of poliomyelitis epidemic outside of New York City — 163
Human autopsy material, collection of — 208
Humidity, relation to New York poliomyelitis epidemic — 132
Hunterdon county, N. J.:
  Description — 188
  Poliomyelitis, 1916—
    Contact history of first case in places investigated — 198
    Contact with previous cases — 199
    Intensive study in — 187
    Record of epidemic — 177, 266
    Spread of epidemic — 170
Hygienic Laboratory, United States:
  Autopsy material from New York epidemic sent to laboratory — 207, 208

I.

Immunity to poliomyelitis, final summary and conclusions — 214
Incubation period of poliomyelitis — 205
  Final summary — 213
  (*See also* Secondary cases.)
Indirect contact. (*See* Contact.)
Infants. (*See* Children; Sex distribution.)
Infection, routes of, in poliomyelitis, knowledge about — 19
Infectiousness. (*See* Multiple cases.)
Initial case. (*See* First case.)
Insects, transmission of poliomyelitis by:
  Final summary — 213, 214
  Knowledge about — 21
Institutions, relation of Richmond poliomyelitis epidemic to — 151
Intensive epidemiological studies. (*See* Richmond, Northeastern United States.)
Interval:
  Between poliomyelitis case from New York city and first local case — 183
  Between departure from New York and onset in communities apparently free from poliomyelitis infection — 184
  Between departure from New York City of poliomyelitis case and development of disease — 183
  Between initial and subsequent poliomyelitis cases in same family, New York epidemic — 129, 158
  Between primary and secondary cases—
    Richmond, poliomyelitis epidemic — 158
    New York, poliomyelitis epidemic — 129
  (*See also* Secondary cases.)
Iowa, poliomyelitis:
  Cases, epidemic, 1910 — 109
  Fatality, 1910 — 119
  Sex distribution, 1910 — 114
Italians, excess in first part of epidemic — 89

J.

Page.

- July cases:
  - New York, poliomyelitis epidemic — 90
  - Richmond — 90, 145
- June cases:
  - New York, poliomyelitis epidemic — 89
  - Richmond, poliomyelitis epidemic — 90, 143

K.

- Kansas, measles:
  - Fatality, 1914–15 — 120
  - Sex distribution, 1914–15 — 115

L.

- Lines of travel: (*See* Travel.)
- Logarithms, mathematical relationships of New York poliomyelitis epidemic — 133

M.

- Maine, poliomyelitis cases, 1916, by weeks — 163, 243
- Male. (*See* Sex distribution.)
- Manhattan Borough:
  - Description — 82
  - Poliomyelitis, 1916—
    - Age distribution—
      - Discussion — 108
      - Variations in, during course of epidemic — 112
    - August cases — 91
    - Fatality — 122
    - Incidence, 1916, children under 10, by assembly districts — 103
    - Interval between initial and subsequent cases in same family — 129
    - July cases — 91
    - June cases — 90
    - Multiple cases in families — 124
    - October cases — 92
    - Paralytic disorders of domestic animals, study of — 206
    - September cases — 92
    - Spread of New York epidemic to Manhattan — 106
    - Weeks, cases by, by assembly districts — 224
    - When first cases occurred — 88
  - (*See* also Boroughs.)
- Maryland, poliomyelitis:
  - Cases, by weeks, 1916 — 163, 250
  - In cities over 10,000 — 260
- Mass movement. (*See* Zones; Travel routes; Spread.)
- Massachusetts, poliomyelitis:
  - Age distribution — 185, 269
  - Comparison of cases, by years, with those in Norway — 33
  - Fatality, 1910–1913 — 119
  - Percentage of first cases apparently exported from New York City — 182
  - Sex distribution, 1909 — 114
  - Weeks, cases by, 1916 — 163, 244
  - Weeks, cases by, cities over 10,000 — 252

Page.
Mathematical relationships of New York poliomyelitis epidemic 133
  Final summary 211
May cases, New York poliomyelitis epidemic 87
Measles:
  Analogy between poliomyelitis and measles 70
  Coefficient of dispersion in different wards, Newark, 1916 100
  Death rates, by States, 1910–1914 75
  Fatality, Kansas, 1914–15 120
  Incidence, Newark, N. J., by wards, spring, 1916 102
  Sex distribution—
    Kansas, 1914–15 115
    Philadelphia, 1912–1916 116
Median. Use in determining spread of New York epidemic 105
Meningitis:
  Sex distribution—
    Philadelphia, 1910–1912 117
    Southwestern United States, 1912 116
Methods and scope of study Richmond poliomyelitis epidemic 139
Metropolitan districts. (*See* Cities.)
Middle case:
  Incidence of poliomyelitis, 1916, by zones according to main lines of travel out of New York City 170
  Richmond poliomyelitis epidemic by wards 146
Middlesex County, N. J.:
  Description 174, 188
  Poliomyelitis, 1916—
    Contact history of first case in towns 197
    Contact with previous cases 199
    Intensive study in 187
    Record of epidemic 175, 265
    Spread of poliomyelitis, 1916 170
Milk supplies, relation to poliomyelitis:
  Final summary 213
  Intensive studies in New Jersey, Connecticut, and Rhode Island 194
  Richmond poliomyelitis epidemic 150
Minnesota, poliomyelitis in:
  Cases, epidemic, 1909 109
  Sex distribution, 1909 114
Miscellaneous cases. (*See* Northeastern United States, intensive studies.)
Miscellaneous studies of poliomyelitis 206
Moisture in air. (*See* Humidity.)
Monkeys: Study of paralytic disorders in 207
Morbidity statistics:
  Of poliomyelitis in United States 44
  (*See also* Reports.)
Mortality statistics, United States 45
Multiple cases of poliomyelitis in same family:
  Final summary 213
  Intensive studies, northeastern United States 201
  New York epidemic 123
  Richmond epidemic 152
Mumps. Sex distribution, Philadelphia, 1910–1912 117

N.

Page.

- Nationality:
  - Distribution of poliomyelitis according to, Richmond poliomyelitis epidemic, 148
  - Final summary, 213
- Newark:
  - Measles—
    - Coefficient of dispersion, 1916, by wards, 100
    - Incidence by wards, spring, 1916, 102
  - Paralytic disorders of domestic animals, study of, 206
- New Brunswick, N. J.:
  - Description, 188
  - Intensive poliomyelitis studies, northeastern United States, 187
- New Hampshire. Cases of poliomyelitis, 1916, by weeks, 163
- New Jersey, poliomyelitis, 1916:
  - Age distribution, 185, 269
  - Percentage of first cases apparently exported from New York City, 182
  - Weeks, cases by, 163, 249
    - In cities over 10,000, 258
  - (*See also* the following counties: Hunterdon, Middlesex, Sussex, Warren.)
- New York City:
  - Description, 81
  - Paralytic disorders in animals, study of, 206
  - Poliomyelitis prior to 1916—
    - Discussion, 85
    - Table of incidence by boroughs, by months, 215
  - Poliomyelitis epidemic, 1916—
    - Age distribution, 102, 107, 119, 186
      - Tables, 228, 229, 230, 231, 233, 236
    - Attack rates, 110, 124
    - August cases, 91
    - Boroughs. (*See* Boroughs.)
    - Case cards used, form of, 84
    - Cases in persons leaving New York City, 182
    - Child population, incidence in, 102
    - Climatological conditions during epidemic, 1[illegible]0, 239, 240
    - Coefficient of dispersion, 100
    - Comparative fatality, males and females, 122
    - Conclusion as to general incidence, 104
    - Conclusions, final summary and, 209
    - Contact as shown by studies in New York City and in northeastern United States, 202
    - Course of epidemic, 89
    - Days, cases by, by boroughs, 219
    - Epidemiological and statistical study, 84
    - Exportation of cases from New York City, 181, 185
    - Family, multiple cases in same, 123
    - Fatality, 118, 235, 238
    - Final summary, 209
    - First cases, percentage of, in infected cities apparently exported from New York City, 182
    - Forecasting decline of epidemic, 134

New York City—Continued.
  Poliomyelitis epidemic, 1916—Continued. Page.
    Health department, comparison with records of Public Health Service onset of cases ... 142
    Incidence—
      By Assembly districts ... 98, 224
      By boroughs ... 96, 215
      Conclusion ... 104
      In child population ... 102
      In general ... 81, 93
    July cases ... 90
    June cases ... 89
    Mathematical relationships ... 133
    Multiple cases in same family ... 123
    October cases ... 92
    Onset, day of—Cases by, by boroughs ... 217
    Onset, by date of, by weeks, incidence and incidence rates ... 223
    Origin of epidemic ... 87
    Radial spread from first focus by zones, cases by week ... 227
    Relation of cases from New York City ... 182
    Reporting of cases ... 92
    Seasonal influence ... 130
    Secondary cases, time of development of ... 129, 203
    September cases ... 92
    Sex distribution ... 114, 119, 122, 236
    Spread of epidemic ... 104
    Statistical and epidemiologic study ... 84
    Summary ... 158, 204
    Summary and conclusions, final ... 209
    Temperature, possible influence on epidemic ... 130
    Time elapsing between departure of case from New York and development of disease ... 183
    Time elapsing between departure from New York and onset in communities apparently free from infection ... 184
    Time elapsing between case from New York City and first case in another city ... 183
    Variations in prevalence in cities according to distance from New York City, 1916 ... 167
    Zones, spread by ... 104
  (*See also* Boroughs; the names of the boroughs; Assembly districts.)
New York State, poliomyelitis in:
  Fatality, 1912 ... 119
  Sex distribution, 1910 ... 114
  Weeks, cases by, 1916 ... 163, 247
    In cities over 10,000 ... 256
Northeastern United States (excluding New York City):
  Poliomyelitis epidemic, 1916—
    General study—
      Age distribution—
        Comparison between cases in metropolitan districts and in rural districts ... 166, 186
        Tables ... 269, 270, 271, 272, 273, 274
        Comparison between New York City cases and those outside ... 186

Northeastern United States (excluding New York City)—Continued.
  Poliomyelitis epidemic, 1916—Continued.
    General study—Continued. Page.
      Beginning of epidemic outside of New York City 163
      Cases, summary 109
      Cases in persons leaving New York 182
      Cities, cases, by weeks 166
      Cases according to population 261
      Counties, cases, by weeks 165
      Epidemic area 162
      Exportation of cases from New York City 181
      First cases—
        Percentage in infected cities apparently exported from New York City 182
      Hartford County—
        Record of epidemic 171
      Hunterdon County, N. J.—
        Record of epidemic 177
      Incidence according to main lines of travel 169, 263
      Incidence by zones, Brooklyn as center 169
      Middlesex County—
        Record of epidemic 175
      Prevalence by State by weeks 163
      Spread by zones from New York City 168, 262
      Spread in small units of population 170
      Summary 204
      States—
        Incidence by weeks 241
        Case rate by weeks 242
      Summary of studies of incidence 179
      Sussex County, N. J—
        Record of epidemic 177
      Time elapsing between departure from New York City and development of disease 183
      Time elapsing between departure from New York City and onset in communities apparently free from infection 184
      Time elapsing between case from New York City and first local case 183
      Variations in prevalence in cities according to distance from New York City 167
      Variations in attack rates according to size of cities 167
      Warren County, N. J.—
        Record of epidemic 177
    Intensive epidemiologic studies—
      Age distribution—
        Secondary cases in families 201
      Contact as shown by studies in New York City and in northeastern United States 202
      Contact relation of first cases to previous foci 196
      Contact relationship between cases 199
      Description of territory studied 188
      Environmental conditions 190
      Milk supply, relations to 194

Northeastern United States (excluding New York City)—Continued.
- Poliomyelitis epidemic, 1916—Continued.
  - Intensive epidemiologic studies—Continued.
    - Miscellaneous cases—
      - Contact with previous cases 200
    - Multiple cases in families 201
    - Occupation—
      - Relations to 195
    - Secondary cases—
      - Development of, as shown in New York City and northeastern United States 203
    - Secondary cases in families 201
  - Final summary 209

Norway:
- Comparison of poliomyelitis cases, by years, with those in Massachusetts 33
- Discussion of poliomyelitis in Norway 33
- Fatality, 1904–1913 119
- First epidemic 25

O.

Occupation—Relation of poliomyelitis to:
- Intensive studies in New Jersey, Connecticut, and Rhode Island 195
- Richmond poliomyelitis epidemic 151

October cases, New York poliomyelitis epidemic 92

Onset of poliomyelitis, day of:
- New York epidemic 217, 219
- Richmond epidemic—
  - By days and weeks 142
  - By wards and weeks 146

Origin:
- New York poliomyelitis epidemic 87
- Richmond poliomyelitis epidemic 142
- Final summary 210

Outside of New York City. (*See* Northeastern United States.)

P.

Paralytic disorders in domestic animals, study of 206

Pennsylvania:
- Common communicable diseases, sex distribution, 1907–1912 234
- Diphtheria, fatality, 1907–1912 120
- Scarlet fever, fatality, 1907–1912 120

Periodicity. (*See* Cycle.)

Personnel engaged in work 9

Philadelphia, sex distribution:
- Measles, 1912–1916 116
- Mumps, chicken pox, whooping cough, meningitis, 1910–1912 117

Plan of studies 10

Population:
- Distribution compared with distribution of cases, New York, 1916 98
- Incidence of poliomyelitis in cities according to population, Northeastern United States, 1916 261

Population—Continued. Page.
- Percentage registration population is to total population 47
- Spread of poliomyelitis in small units of population, 1916 170

Prediction of decline of New York poliomyelitis epidemic 134

Prevalence of poliomyelitis:
- Before 1916 24
  - World prevalence 24
  - Prevalence in United States since 1909 44, 215
- Epidemic in New York City in 1916 81, 217
- Epidemic outside of New York City in 1916 77, 161, 241

Previous cases. (*See* Contact.)

Previous writers, age distribution of poliomyelitis in certain States, by cities, according to size, age groups used by previous writers 273

Problem of poliomyelitis 11

Progress of New York poliomyelitis epidemic not affected by minor factors 137

Providence, R. I.:
- Diphtheria—
  - Attack rates, initial and subsequent, in families, 1904–1913 125
  - Incidence in general population and in persons in family with case 127
  - Interval between initial and subsequent cases in same family 129
- Scarlet fever—
  - Attack rates, initial and subsequent 125
  - Incidence in general population and in persons in family with case 127
  - Interval between initial and subsequent cases in same family 129

Public health service, comparison with health department records, onset of cases 142

Q.

Queens, Borough of:
- Description 83
- Poliomyelitis, 1916—
  - Age distribution 108
  - August cases 91, 143
  - Fatality 122
  - Interval between initial and subsequent cases in same family 129
  - June cases 91
  - July cases 90
  - Multiple cases in families 124
  - October cases 92
  - September cases 92
  - When first cases occurred 88
- (*See also* Boroughs.)

Questionnaire, Form used in studies of paralytic disorders of domestic animals 206

R.

Radial spread. (*See* Zones; Spread.)

Rainfall, relation to New York poliomyelitis epidemic 132, 239, 240

Ratio of males to females. (*See* Sex distribution.)

References. (*See* Bibliography.)

Page.

Registration area, United States, Discussion of 47

Reporting of cases, discussion of delay 93

Rhode Island, poliomyelitis in, 1916:
  Age distribution 185, 269
  Contact with previous cases 200
  Intensive studies of scattered cases 190
  Percentage of first cases apparently exported from New York City 182
  Weeks, cases by 163, 245
    In cities over 10,000 255

Richmond:
  Description 83, 138
  Poliomyelitis, 1916—
    Abortive cases of—
      Question of inclusion 154
      Where direct contact is shown 158
    Age distribution, 1916 108
    August cases 91
    Card, used in study case 139
    Case rates—
      According to nationality 149
      By wards 148
    Conditions (environmental) relations to 149
    Contact as shown by studies in New York City and in northeastern United States 202
    Contact with previous cases 156
    Course of epidemic 142
    Days, onset of cases by (comparison of Public Health Service and Health Department records) 142
    Direct contact 156
    Environmental conditions, relating to 149
    Families—
      Grouping of primary and secondary cases 154
      Multiple cases in 152
      Occupations of wage earners 152
      Secondary cases in 153
    Fatality 122
    Final summary 209
    First case 143
    Food—
      Relations to milk supply 150
    Geographic distribution of cases 146
    Grouping of primary and secondary cases in families 154
    History of cases—
      June 143
    Indirect contact 156
    Institutions, relations to 151
    Interval between initial and subsequent cases in same family 129, 158
    July cases 91, 145
    June cases 90, 143
    Methods of study 139
    Middle cases, by wards 146

- Richmond—Continued.
  - Poliomyelitis, 1916—Continued. Page.
    - Milk supply, relations to ... 150
    - Multiple cases in families ... 124, 152
    - Nationality—
      - Distribution of cases according to ... 148
    - Occupations of wage earners in families having cases ... 151
    - October cases ... 92
    - Onset of cases—
      - By days and weeks ... 142
        - (Comparison of Public Health Service and Health Department records.)
      - By wards and weeks ... 146
    - Origin of epidemic ... 142
    - Previous cases, contact with ... 156
    - Schools, relations to ... 151
    - Scope of study ... 139
    - Secondary cases in families—
      - Development of secondary cases as shown by combined studies ... 203
      - Discussion ... 153
      - Time interval between primary and secondary cases ... 129, 158
      - Grouping of primary and secondary cases in families ... 154
    - September cases ... 92
    - Spread of New York epidemic to Richmond ... 106
    - Summary ... 141, 204
    - Suspicious cases—
      - Question of inclusion in records ... 154
      - Where direct contact is shown ... 158
    - Time interval between primary and secondary cases ... 129, 158
    - Wards—
      - Case rate by ... 148
      - Middle cases by ... 146
      - Onset of cases by weeks ... 146
    - Weeks—
      - Onset of cases—
        - By wards ... 146
        - Comparison of Public Health Service and Health Department records ... 142
    - When first case occurred ... 88
  - (*See also* Boroughs.)
- Rodent surveys ... 208
- Routes of poliomyelitis infection, knowledge about ... 19
- Routes of travel. (*See* Travel.)
- Rural and urban districts compared, as to incidence of poliomyelitis:
  - Age distribution—
    - New York epidemic ... 108
    - Northeastern United States ... 186, 271
  - Distribution of deaths, 1910–1915, by States ... 80
  - Final summary ... 212
  - Incidence recent epidemics, United States ... 109
  - Tendency to lower rates in cities, general epidemic, 1916 ... 166

S.

Page.

Sanitary surroundings, relation to poliomyelitis, final summary 213

Scarlet fever:
- Attack rates, initial and subsequent, in families having cases, Providence, R. I., 1904–1909 125
- Coefficient of dispersion in different wards, Chicago, 1910 100
- Fatality, Pennsylvania, 1907–1912 120
- Incidence, Chicago, by wards, 1910 101
- Incidence in general population and in persons in family with case, Providence, R. I. 127
- Interval between initial and subsequent cases in same family, Providence, 1904–1913 129
- Sex distribution, Pennsylvania, 1907–1912 234

Schools, relation of Richmond poliomyelitis epidemic to 151

Scope and methods of study, Richmond poliomyelitis epidemic 139

Seasonal prevalence of poliomyelitis.
- Cases, by States, with rates per 100,000, 1916, months of epidemic prevalence 78
- Knowledge about 16
- Effect on New York poliomyelitis epidemic 132

Secondary cases (poliomyelitis):
- Development of secondary cases, as shown in New York City and northeastern United States 203
- Final summary 213
- Grouping of primary and secondary cases (in families) Richmond poliomyelitis epidemic 154
- Intensive studies, northeastern United States 201
- Richmond poliomyelitis epidemic 153
- Time interval between primary and Richmond epidemic 158
- Time of development of New York epidemic 129

Secondary cases in families:
- (Wickmann) 130

Sex distribution:
- Chickenpox, Philadelphia, 1910–1912 117
- Diphtheria, Pennsylvania, 1907–1912 234
- Measles—
  - Kansas, 1914–1915 115
  - Philadelphia, 1912–1916 116
- Meningitis—
  - Philadelphia, 1910–1912 117
  - Southwestern United States, 1912 116
- Mumps, Philadelphia, 1910–1912 117
- Poliomyelitis—
  - Comparative fatality, males and females, New York epidemic 122, 238
  - " " morbidity " " " " " 233
  - Fatal cases, sex and age distribution of, New York City, 1916 236
  - Fatality by sex and age 119, 238
  - Males, excess of, New York epidemic 117
  - Previous epidemics, United States 114
- Scarlet fever, Pennsylvania, 1907–1912 234
- Typhoid fever, Pennsylvania, 1907–1912 234
- Whooping cough, Philadelphia, 1910–1912 117

Page.

- **September** cases, New York poliomyelitis epidemic, 92
- **Social** status, relation to poliomyelitis, final summary, 212
- **Sources** of infection in poliomyelitis, 15
- **Southwestern** United States, meningitis, sex distribution, 1912, 116
- [illegible]adic occurrence of poliomyelitis, 17
- **Spread** of poliomyelitis:
  - By zones from New York City, 1916, 168
  - Cause—
    - Final summary and conclusions, 211
  - Greater New York, 1916, 107
  - In small units of population, United States epidemic, 1916, 170
  - New York City, 104
  - (*See also* Geographic distribution; Zones.)
- **Standard** deviation. (*See* coefficient of dispersion.)
- **States**:
  - Measles, death rates, 1910–1914, 75
  - Poliomyelitis—
    - Age distribution, northeastern United States—
      - According to size of cities, 273
      - By States, 270
    - Case rate, United States, 1911–1915, 87
    - Cases, 1916, with case rates, 78, 241, 242
    - Cases, by weeks, by counties, 1916, 165
      - Tables, 243, 244, 245, 246, 247, 249, 250
    - Comparison of Massachusetts cases with those in Norway, by years, 33
    - Deaths and cases, United States, 1909–1915, by States and geographic divisions, 48
    - Deaths, 1910–1915, urban and rural and age distribution, 80
    - Deaths and cases, 1916, 77
    - Death rates, 1909–1915, 59, 70
    - Final summary, 209, 212
    - Maps showing prevalence (deaths), 1909–1915, 71
    - Percentage which registration population is of total population in each State and geographic division, 47
    - Prevalence, by weeks, 1916, 163, 241, 242
- Subsequent cases. (*See* Secondary.)
- Successive groups, age distribution in, poliomyelitis, New York City, 1916, 231
- Summary, New York poliomyelitis epidemic, 158
- Summary, 204, 209
- Susceptibility of populations to poliomyelitis, 214
- Suspicious cases, Richmond poliomyelitis epidemic:
  - Question of inclusion in records, 154
  - Where direct contact is shown, 158
- Sussex County, N. J.:
  - Description, 188
  - Poliomyelitis, 1916—
    - Contact history of first cases in places investigated, 198
    - Contact with previous cases, 190
    - Intensive study in, 187
    - Record of epidemic, 177, 268
    - Spread of poliomyelitis, 170
- Sweden, southern, case fatality, poliomyelitis, 1905, 119

T.

Page.

Temperature, New York poliomyelitis epidemic 132, 239, 240
Time elapsing. (*See* Interval.)
Transmission of poliomyelitis dust in New York epidemic 132
Travel routes:
  Final summary 212
  Incidence of poliomyelitis, by zones, northeastern United States, 1916 263
  Incidence according to main lines of travel, United States epidemic, 1916 169
Typhoid fever, sex distribution, Pennsylvania, 1907–1912 234

U.

United States, poliomyelitis in:
  Prevalence since 1909 44
  Record of prevalence, 1916 34
  Final summary 209
Urban and rural districts compared as to incidence of poliomyelitis:
  Age distribution, New York epidemic 108
  Comparison in age distribution between rural and metropolitan cases, epidemic northeastern United States, 1916 186
  Distribution of deaths, 1910–1915, by States 80
  Final summary 212
  Incidence recent epidemic, United States 109
  Tendency to lower rates in cities, general epidemic, 1916 166

V.

Velocity of movement of New York epidemic wave. (*See* Spread.)
Vermont, poliomyelitis cases, 1916, by weeks 163, 246
Veterinarians, questionnaire sent to, in study of paralytic disorders in domestic animals 206
Virus of poliomyelitis 14

W.

Wage earners. (*See* Occupation.)
Wards, Richmond poliomyelitis epidemic:
  Case rate by 148
  Middle cases by 146
  Onset of cases by, by weeks 146
Warren County, N. J.:
  Description 188
  Poliomyelitis, 1916—
    Contact history of first cases in places investigated 198
    Contact with previous cases 199
    Intensive study in 187
    Record of epidemics 177, 267
    Spread of poliomyelitis 170
Washington 114
  (*See* District of Columbia.)
Water, relation to poliomyelitis, final summary and conclusions 213
Wave, epidemic. (*See* Spread; Zones.)

Weeks, poliomyelitis (1916):
  Case rate by weeks— Page.
    New York 95
    Northeastern United States 241
  Cases by weeks—
    New Jersey and Connecticut 264
    New York City 95, 223, 224
    Northeastern United States 163, 241
  Cities, cases by 166, 252
  Counties, cases by 165, 243
  Fatality by, New York epidemic 118, 235
  Forecasting decline of New York epidemic 134
  Mathematical relationships in New York epidemic 134
  New York epidemic, cumulative 96, 223
  Onset of cases by, Richmond epidemic 142
  Onset by weeks 146
  Radial spread—
    Brooklyn, by zones 224
    New York, by zones 226
    Northeastern United States 262
  (*See also* Chronology.)
West Feliciana, La., account of epidemic at 24
Westfield, Mass., June cases of poliomyelitis 163
Whooping cough, sex distribution, Philadelphia, 1910–1912 117
World prevalence of epidemic poliomyelitis 24
  Summary and conclusions 209

Z.

Zones, concentric:
  Final summary 211, 212
  Greater New York, radial spread of poliomyelitis 107, 227
  Incidence by, Brooklyn, 1916 104, 106, 226
  Progress of crest of spread, New York epidemic 107
  Spread of poliomyelitis by, from New York City, 1916 168, 262
  Travel, main routes of, incidence by zones 263
  Use in determining spread of New York epidemic 105

RELATED PUBLICATIONS.

[Literature in regard to poliomyelitis issued by the United States Public Health Service, from which copies may be obtained without charge.]

HYGIENIC LABORATORY BULLETIN:

90. Epidemiologic Studies of Acute Anterior Poliomyelitis. I. Poliomyelitis in Iowa, 1910. II. Poliomyelitis in Cincinnati, Ohio, 1911. III. Poliomyelitis in Buffalo and Batavia, N. Y., 1912. By Wade H. Frost. October, 1913. 258 pages. 38 charts. Paper.

PUBLIC HEALTH BULLETIN:

44. Acute Anterior Poliomyelitis (Infantile Paralysis). A. Précis. By Wade H. Frost. February, 1911. 52 pages. 3 charts. Bibliography.

91. Epidemiologic Studies of Poliomyelitis in New York City and the Northeastern United States during the year 1916. By C. H. Lavinder, A. W. Freeman, and W. H. Frost. January, 1918.

REPRINTS FROM PUBLIC HEALTH REPORTS:

55. The Field Investigation of Epidemic Poliomyelitis (What the Health Officer Can Do Toward Solving a National Problem). By W. H. Frost. November 18, 1910. 19 pages. References. Paper. (As this reprint is out of print, copies of it can not be obtained from any governmental source.)

99. Transmission of Poliomyelitis by Means of the Stable Fly (Stomoxys Calcitrans). By John F. Anderson and Wade H. Frost. October 25, 1912.

140. Poliomyelitis (Infantile Paralysis.) A Report of an Outbreak in Texarkana and Vicinity. By Edward Francis. August 15, 1913.

229. Poliomyelitis (Infantile Paralysis). A preliminary note on the epidemic in Vermont during the summer and fall of 1914. By Charles S. Caverly, president, Vermont State Board of Health. October 23, 1914.

350. Poliomyelitis (Infantile Paralysis). What Is Known of Its Cause and Modes of Transmission. By Wade H. Frost. July 14, 1916.

361. Poliomyelitis (Infantile Paralysis). Its Interstate and Intrastate Control. Minimum Requirements for its Control. Reports of committees adopted by the special conference of State and Territorial health authorities with the United States Public Health Service, Washington, D. C., August 17 and 18, 1916.

373. Poliomyelitis (Infantile Paralysis). Present Knowledge of its Cause and Manner of Spread. November 3, 1916.

403. Poliomyelitis (Infantile Paralysis). Prevalence and Geographic Distribution During 1916. June 29, 1917.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
45 CENTS PER COPY
▽

COUNTWAY LIBRARY
HC 2HZX U